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from your president

It is indeed a genuine pleasure to announce the granting of a State Unit Charter to the New Mexico Society of Dentistry for Children. I sincerely trust this affiliation will further inspire its members to better serve the dental health needs of our children.

The American Society of Dentistry for Children's Committee on Membership and State Units, chaired most competently by Albert Anderson, has recently placed in the A.D.A. Journal an advertisement proclaiming the value of A.S.D.C. membership. This committee is also endeavoring to establish a Junior Membership in our Society by contacting the senior students in the nation's dental colleges. The primary purpose, of course, is to increase our membership enrollment and by so doing, to strengthen the State Unit Societies. I, therefore, earnestly solicit the full cooperation of the State Unit Secretaries, to assure the utmost success of this most ambitious membership campaign.

The Annual Meeting Committee is working most diligently to again present an outstanding scientific meeting with the usual enjoyable sociability. I suggest you carefully read, elsewhere in this issue, the tentative program of this meeting and to please fill out the pre-registration form, mailing it promptly to Dr. Victor Lenchner, 705 71st Street, Miami Beach 41, Florida. Your prompt action will assure you of a reservation in our fabulous Convention hotel, the Balmoral, and will be of inestimable assistance to the Committee in assuming necessary guarantees for your convenience.

— IT'S MIAMI BEACH IN '57 —

LARRY BURDGE

A Digest of the Practice of Pedodontics—cont'd.

SAMUEL D. HARRIS, D.D.S.

CHAPTER X
Copper Amalgam

THERE is considerable difference of opinion among those doing dentistry for children regarding the value of copper amalgam. Barker states:

> "I have used copper amalgam perhaps more than any pedodontist now practicing. I have removed copper amalgam fillings surrounded by caries and have found the caries completely inhibited at the point of contact with the copper amalgam filling. In 1922 a dentist who was widely known as a research scientist explained its germicidal qualities to me as resulting from 'the gradual precipitation of copper salts when the saliva acts on the amalgam'."

Rogers considers copper amalgam an ideal filling material and Stine supports its use. Lampshire, however, states that it is germicidal only as it goes into solution. Massler, quoting Turkheim, says there is action on bacteria only during its period of setting, and adds that it is highly injurious to pulps. Lloyd sees no real advantage in using copper amalgam, and Wood says that in his opinion it is slow setting, hard to handle, and has poor adaptation.

Since copper amalgam has been advocated by this writer primarily for small proximal spot fillings in posterior teeth and for shallow class V fillings, neither with a size or depth greater than a number 35 bur, it is our observation that its possible injurious quality to the pulp would here be of no consequence. It is true that some copper amalgam sets slowly. This is copper amalgam which is poorly manufactured. The Bureau of Standards has not insisted that copper amalgam be of acceptable quality. Some is and some is not.

It is this writer's considered opinion that this filling material has not been tested adequately by research scientists under the conditions prevailing in the mouth; also that a high quality copper amalgam, as carefully prepared for insertion as is silver amalgam, unquestionably does present important advantages in the specific areas where its use has been advocated (pages 142–143, Vol. XXI).

ROGERS, FRED H.: Some Practical Points on Children's Dentistry. Journ. Orthodont. **21:** 1163–1170, December, 1935.

SCHARFENBERG, ROSS F.: Copper Amalgam Does Not Belong in Dentistry for Children. J. Dent. Child. **16:** 1–4, (2nd. Quart.), 1949.

CHAPTER XI

Restorative Materials

THERE is general agreement that silver amalgam is by long odds the restorative material of choice in dentistry for children. Miller[1] offers the suggestion that the amalgam "properly triturated should be too mercury rich to be condensed effectively and needs mercury expression before it is inserted into the cavity for condensation". Smith stresses the value of depth of amalgam as much as width through the isthmus in a class two preparation.

In regard to the matrix of choice, Guest states:

> "Welded matrix bands are proving to be a wonderful help in my office. I find that wedges of plastic or round toothpicks, stimudents, etc. prevent amalgam overhangs when I use the mechanical vibrator."

Cody and Taylor are in complete agreement with this. Ireland suggests the following:

> "This matrix also may be used for distolingual cavities in cuspids. By cutting a half-moon portion from the lingual side of the band, the silver amalgam can be placed and condensed in the cavity from the lingual aspect. If necessary, this type of matrix band can be left around the tooth for several days. When it is time to remove it, the operator can open the soldered joint by cutting it with a knife-edged stone or by prying it apart with a spoon excavator."

It is essential to note that the matrix material used here is steel, for it is as Martin remarks, "All kinds of matrix material cannot be welded." Burdge has this to say:

> "For those who do not have a welding machine," (incidentally a very essential piece of equipment in Pedodontics), "it would seem desirable to suggest a matrix of practical application. The copper T matrix, used extensively at Forsyth, is easily adapted and contoured. The use of Hogeboom's right angle scissors # 13 for cutting chrome bands could be useful.[3]"

Everyone agreed that a protective base or lining should be used under restorations of moderate depth. As Erwin expressed it, ". . . bases never hurt a service." Additionally, more and more dentists are becoming selective of basing materials. This has been in response to a report by Massler in 1954 on the effect of filling materials on dental pulps.

He found that the use of zinc oxide-eugenol cement produced minimum alteration in the dentin and none in the pulp while silicate cement and copper cement produced death of odontoblasts. The order of effect increased from zinc oxide-eugenol to amalgam, self curing acrylics, zinc phosphate cements, silicates, and copper cements. On the basis of this study, the use of zinc-phosphate cement alone as a protective base in extremely deep cavities in children is questioned. Cavity varnish was found to be completely ineffective in protecting the pulp against injury by silicates.

Calcium compound liners were found to be very effective in this respect. At

least four tests were made for each material. The results show that a calcium hydroxide-pholystyrene mixture (Chembar) was most effective in protecting the pulp, followed by a paste composed of calcium hydroxide in methyl-cellulose (Pulpdent). Zinc Acetate c.p. or reagent can be added to zinc oxide-eugenol as a neutral accelerator. Erwin states, " . . . it will then set as fast as a thick mix of cement."

The caution is offered by Lloyd that it is risky to leave a cement restoration in a tooth for any period of time. This holds even more true with gutta percha. For this reason, when Lloyd uses cement as a temporary filling, two layers of cement are employed, the first is allowed to harden before the second is placed. Easlick, however, feels this is "a plain waste of time".

There is reasonably conclusive evidence that cement is not a good sealing agent. Massler and Ostrovsky,[4] confirming Grossman's (1939) report and those of others, showed in 1954 that, even under ideal conditions, marginal leakage occurred within 24 hours with base plate gutta percha, temporary stopping, zinc phosphate cement, and self-curing acrylic resin employed as filling. Silicate cement preserved its marginal seal somewhat longer (up to a maximum of 13 days). Zinc oxide and eugenol and amalgam showed the most effective marginal sealing qualities.

Thus, in extremely deep cavities it will be wise to place a little zinc oxide-eugenol cement first. This should be covered by phosphate cement. The greater hardness of the latter cement makes it the best material for a foundation for amalgam.

Coleman asks, "What do you think about chrome steel crowns for badly broken-down molars—or anteriors?" I have had little occasion to use them for anteriors. For posteriors, although they do not give as good a gingival fit as does the banded amalgam restoration in Part I, Chapter IX, I think chrome crowns have considerable merit.

Humphrey, the "father" of the chrome crown, wrote me, "I put the first crown in a child's mouth in 1947, and they have been in use ever since then."

Today chrome crowns are very popular and fill a real need particularly in restoring badly broken down primary molar teeth. They are especially useful when pulpectomies or pulpotomies have been performed; inasmuch as such teeth are brittle and fracture easily under masticatory stress.

My technic for selection and preparation of the crown varies somewhat from that advocated by its manufacturer. Three sizes of crown for each primary molar are available. The correct size is the one that will slip over the entire tooth but with some effort. Having selected the desirable size, I trim about a sixteenth of an inch from the lingual (if a lower) or from the labial (if an upper) gradually sloping the gingival margin to the opposite surface of the crown. The crown is then tried on the tooth and the gingival edge adjusted until the restoration goes just below the free margin of the gum on all sides. It is important to note the correct occlusion before placing the crown and to make certain that the occlusion is not disturbed when the crown is cemented to place. The crown is then removed from the tooth, and its edge is stoned sharp and polished. Then it is cemented

onto the tooth. If the cementing is done with a rocking motion, the excess cement escapes and no pinhole is required in the crown for this purpose.

After reading this, Massler still holds, "I much prefer a good pinch band of stainless steel". Kelsten[5] advocates the use of a cast crown inasmuch as it is far more exact and, therefore, less injurious to gingival tissue. He asserts that the cast crown is more securely retained and thereby assures better contact, contour, and occlusion.

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CHAPTER XII

Pulp Capping and Pulpotomy

PULP CAPPING in primary teeth is looked upon with favor; however the degree of success reported with pulpotomy (removal of part of the pulp) varies considerably. Pulpectomy (complete removal of the pulp tissue) is generally considered with disfavor.

For pulp capping to be successful, Rosenstein suggests that the pulp exposure should be: (1) sensitive to touch; (2) slightly hemorrhaging; (3) located in dentin of normal color. If these three conditions are present, he states that the tooth, primary or permanent, may be judged amenable to capping. His proportion of success with over five hundred patients who returned for recheck over a ten year period is 90.4 per cent.[1]

Rosenstein uses phenol prior to application of the pulp capping for its germicidal and cauterizing effect. Today's capping of choice appears to be calcium hydroxide. This is covered with a thin layer of zinc oxide-eugenol over which is flowed zinc phosphate cement to provide an adequate foundation for the permanent filling.

The thin layer of zinc oxide-eugenol between the calcium hydroxide and the cement will greatly increase the per cent of success; otherwise the acid of the cement can penetrate the pulp capping. Massler states "... the zinc-oxide eugenol seals and protects against the acid of the cement and is also antiseptic."

Eichenbaum and Dunn,[2] examining over five hundred children, found that

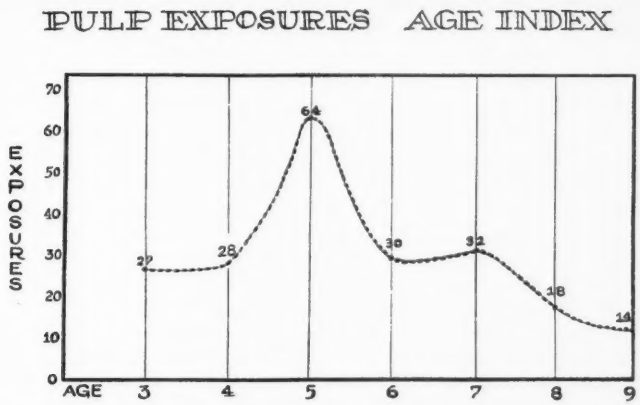

FIG. 15. Pulpotomy graph—Numerical analysis of 511 children places the peak of pulp exposures at about five and one-half years of age. In this age group the number of exposures clinically apparent was about equally divided between first and second primary molars.

fully 36 per cent of the three year olds examined already had molar pulp exposures (Figure 15).

Capping is resorted to if the exposure is minute and of instrumental origin, pulpotomy if it is somewhat larger. Primary teeth with roots at least half unresorbed or permanent teeth with wide apical openings are the most desirable subjects for pulpotomy.

The patient should be cooperative. The object of pulpotomy is removal of only the bulbous portion of the pulp, leaving intact and alive the pulp tissue in the root canals.

Following x-ray and anesthesia, Easlick[3] utilizes the following technic for pulpotomy: The pulp chamber is opened with a fissure bur. A large round bur is revolved about the chamber floor to amputate the pulp at the level of the openings to the root canals. Bleeding is absorbed and the pulp chamber cleaned with sterile cotton pellets. A paste of calcium hydroxide is placed over the resected stumps of the pulp[4] (Teuscher 1938, Zander 1939, Retarski 1940, Easlick 1943) and covered by a layer of zinc oxide-eugenol (Massler). Zinc phosphate cement is placed over the zinc oxide-eugenol to provide a firm base for the permanent filling.

The reported degree of success with pulpotomy varies. Thus, at the American Academy of Pedodontics meeting in 1954, Law reported 51 % success, observing 210 cases over a six to twelve month period. Erwin reported 87 % success with 36 cases observed six months to 11 years. Via,[5] selecting 103 cases from 800 pulpotomies on file at the University of Michigan averaging twenty-five months, reported that only 31.1 % were successful. In 1950 Law reported 98.7 % success on 39 cases observed over a six year period.

Tobin[6] of Guggenheim, reported 15,000 pulpotomies, including both primary

and permanent teeth, concluded that permanent teeth showed a higher per cent of success. Judiciously employed, Tobin feels that pulpotomy is a useful and important operation. He suggests that on young permanent teeth it may be a desirable treatment if it does no more than tide over the period until the root ends can be completed, thus permitting subsequent complete pulp canal therapy.

Few men, even among those who confine themselves to pedodontics, advocate complete root canal therapy on primary teeth; however Rabinowitch,[7] in 1953, reported a careful ten year study of 1353 selected cases only seven of which he listed as failures. By his method the number of visits required for complete root canal treatment ranged from 5–6 for the treatment of infected vital primary molars to 7–9 for the treatment of infected non-vital primary molars.

Easlick stated in a personal communication to Cabot in 1954 that scientific root canal therapy is not feasible in the primary molars as the morphology of the root canals is unpredictable and unsuitable for treatment. Smith adds, "I don't know anyone who ever succeeded in getting two successive negative cultures from a primary tooth."

There is complete agreement among clinicians in one respect. If a primary tooth with an exposed pulp cannot be restored to a satisfactory state of health, it should be extracted. Permitting abscessed teeth to remain unattended in the oral cavity amounts to a rendezvous with disaster.

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5. Via, William F., Jr.: Evaluation of Deciduous Molars Treated by Pulpotomy and Calcium Hydroxide, J.A.D.A. **50:** 34–43, January, 1955.
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CHAPTER XIII

Fractured Incisors

HALLETT[1] notes the fact that irregular or malpositioned incisors are especially liable to damage and fracture. Based on an examination of 7670 patients, he points to the superior protrusion case as:

> "... five times more vulnerable to incisal traumatisms than those whose incisors are within normal limits of axial inclination". He continues, "Add to this fact that 990 of the school children of my district show some degree of injury to their anterior teeth, and we can see that the problem is a very real one".

For temporary restoration of A, B, or C degree fracture, (Page 206) Burdge uses a small pin and acrylic as does Wood. Wood claims:

> "This method gives terrific retention and good esthetics with small loss of tooth structure. We use acrylic rather than the silicate crown form and acrylic instead of silicate. We have used this as the temporary restoration in Toronto with better results. It stays on well. The procedure is as follows: The fractured area is capped and an acrylic crown form selected. A hole is cut with a round bur on the lingual. Acrylic is placed in the crown form and this is temporily placed on the tooth. After the acrylic has set, the crown is removed and excess acrylic is cut off. Then the crown is cemented back on the tooth. This is left on for approximately 30 days, then a more permanent restoration is made."

Collett and McGrath, of the Navy Dental clinic, offer this interesting method for preparing a permanent acrylic jacket by the direct method.

1. Tooth prepared, conventional jacket preparation, shoulder somewhat heavier.
2. Select an acrylic stock tooth of the proper color and shape, slightly larger than is required. Hollow out the lingual, leaving the labial, the mesial and the distal intact-so that the crown fits freely over the preparation.
3. Lubricate the preparation with petrolatum. Cover with a thin coat of resin. Leave to set for three minutes. Paint a small bead of acrylic on the mesial and distal incisal angles to help retain a Fiberglass thread reinforcement.
4. Wrap on a layer of Fiberglass thread. Cover this with a thin layer of acrylic.

5. Fill the stock tooth with resin. Place over preparation incorporating the Fiberglass covered veneer.
6. Mould the acrylic on the lingual to shape. Paint on more if needed. Let set for 5 minutes. Remove entire crown. Let set for 10 minutes.
7. Trim excess. Shape. Adjust to occlusion. (The Fiberglass must be entirely covered as it cannot be polished).
8. Paint shoulder with acrylic. Replace on lubricated preparation under pressure. This will compensate for shrinkage or inaccuracies. Let set for 5 minutes. Remove, trim, polish.
9. Clean off lubricant. Cement crown to place.

The following reveals Wood's suggestion as to whether or not a pulpotomy should be performed on a fractured incisor:

"Whether the fractured tooth will require a pulpotomy or not will depend on several factors.

a. Tooth vitality.
b. Size of exposure.
c. Is the end of the root closed or not.
d. Have I enough tooth structure present to do a restoration if I do a pulpotomy?

Two years ago I did two beautiful pulpotomies—calcium bridge and all. Then, when I came to do my restoration, I did not have enough crown left to do it. I had to do a pulpectomy and then use a post crown."

Taylor and Smith both feel that waiting until 14 to 16 years of age for a permanent restoration is waiting too long. Taylor suggests that rather than set a chronological age, a developmental age would be more practical.

1. Hallett, G. E. M.: Problems of Common Interest to the Pedodontist and Orthodontist With Special Reference to Traumatized Incisor Cases, 1953 Transactions of the European Orthodontic Society.

CHAPTER XIV

Space Maintenance and Pre-Orthodontics

IN ORDER that sufficient emphasis may be placed upon prophylactic orthodontics, consider that Brandhorst[1], from a study of over 100,000 St. Louis school children, has stated that the controllable or preventable factors represent 81 per cent of the causes of dento-facial anomalies. In other words, only 19 per cent of the malocclusion that develops should require those major biomechanical treatment procedures that only the qualified specialist in orthodontics can give. Weber[2] says:

"In the light of these figures it would seem apparent that if the profession's orthodontic service to the public is ever to approach a point where it may be comprehensive enough to be adequate, there must be brought to the realization of the man in general practice the importance of his role in the field of prevention.

Some of the malocclusion that lies within the capabilities of the man in general practice to prevent are those caused by:

1. Thumb and finger sucking.
2. Lip biting, lip sucking, cheek sucking.
3. Loss of proximal contact.
4. Improper dental restorations.
5. Ectopic eruption of first permanent molars.
6. Impacted, unerupted or supernumerary teeth.
7. Too long retention of primary teeth.
8. Early loss of primary teeth.
9. Loss of permanent teeth.
10. Developing incisor crossbites."

Freud has shown that infantile sucking is instinctive and natural. Sears and Wise, Klachenberg, Roberts, and others showed that thumb sucking exists in one-half to two-thirds of children in the first year of life.

Lewis[3] found in a study of 170 children that one out of four were thumb suckers. Of these, four out of five had a related malocclusion. The habit continued beyond five years old in one-third of the children. Of these, nine out of ten had a related malocclusion. If the habit stopped before five, one out of three showed self correction, two out of three did not.

"Thumb-sucking in children above the age of five or six is not to be viewed as casually as in younger children. The symptom is usually a manifestation of a general emotional and social immaturity which, unless corrected, may lead to a serious and lasting personality disorder."[4]

"Treatment of thumb-sucking should be directed primarily towards the discovery and elimination of the basic emotional factors causing the act. 'Breaking the habit' is never indicated unless a dental deformity actually exists. If dental deformity does exist, it is necessary to transfer the act of thumb-sucking to some other less noxious form of activity such as carving, drawing, etc."

"To the properly trained dentist, thumb-sucking gadgets or devices are used only as therapeutic aids—never as corrective (i.e. punishing) devices."

"Tongue and lip sucking or biting may have the same psychogenic origin as finger sucking, and are frequently seen to occur in restrained finger suckers."

"Another habit which is not so noticeable is the one of drawing in the lower lip and biting it. It not only causes a malocclusion of the teeth, but also the lower lip becomes thickened and enlarged."

"Young, growing bones react readily to these pressures, and even seemingly 'harmless' or 'slight' habits may over a period of years lead to a definite distortion of the face or jaws."

"The oral screen, which has gained much favor in the United States during recent years, is recommended as a preventive appliance in lip biting and tongue thrusting and as an orthodontic appliance for treating extreme overjet, overbit, and open-bite."[6]

Humphries suggests that prescriptions and simple devices may help.

"*A Prescription for Thumb Sucking and Nail Biting*

Tr. Capsicum 3.

Tr. Asafetida 3. If this does not work add Tr. Aloes 3.

Flux Collodion 3.

Sig: Place on thumb or nails as directed.

(Shake well, place in applicator bottle). If this does not work, use a band or anterior crown and solder three .028 steel wire lugs on the lingual. *If the child wants to stop* thumb sucking, lip biting, or tongue thrusting this will work."

In case of an ectopic eruption where a permanent molar is erupting at an angle and somewhat impacted against the distal of the second primary molar, if slight, the impaction is easily corrected. The permanent molar may be freed from its impacted relation and the ectopy remedied by inserting a 22 gauge brass ligature wire cervical to the point of contact of the primary, and permanent molars.

If the impaction is more severe, as in (a), (Figure 16) then the distal portion of the second primary molar is removed (b) with a safe side disc and the tooth covered with a chrome or cast crown. The distal of the crown is contoured (c) to deflect the erupting permanent molar into its correct position.

Supernumerary teeth are not uncommon in children. Complex malocclusion may be prevented by detecting and taking steps to extract them promptly. If the tooth has not yet erupted, it may be desirable to wait for its eruption depending on whether its extraction before eruption will endanger other teeth.

"Occasionally primary teeth are retained too long because the position of the succedaneous tooth is such as to assist resorption of only one aspect of a root or one root of multirooted primary teeth. This is said in full recognition of the fact that pressure of the erupting succedaneous tooth is not the only factor in resorption of the roots of primary teeth. When the ectopy of the succedaneous tooth fosters the prolonged retention of the primary tooth, careful clinical or roentgenographic examination will discover it and extraction of the primary tooth will correct it."[2]

"Another possible cause of too long retention of primary teeth is an

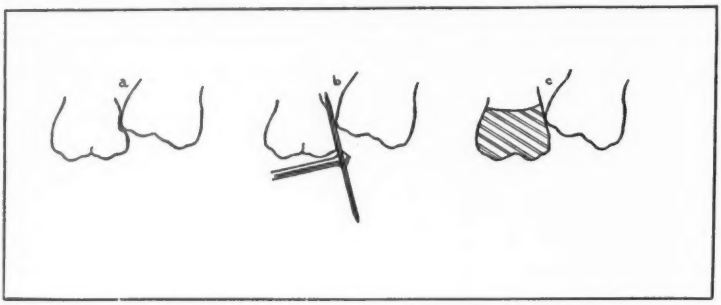

FIG. 16. Correcting position of ectopic first permanent molar

ankylosis between the root and alveolar bone. These so-called 'submerged' teeth are diagnosed from the clinical signs that reveal them to be short of the normal occlusal plane. Continued vertical growth of the adjacent teeth and their alveolar processes gives the impression that the ankylosed tooth is submerging. If these teeth are not exfoliated at the proper time, their retention may favor the development of malocclusion. Careful observation of these teeth, with timely extraction when necessary, may well be a valuable type of prophylactic orthodontic service."

The early loss of primary teeth is conservatively estimated as causing over 50% of malocclusion. Lyons, of Jackson, Michigan, in a study of 5,000 children aged 5–12 years places the figures at 65%. Schacter, in a careful survey in Britain, shows the percentage to be well over 50%. The study of 100,000 school children of St. Louis, previously mentioned, showed that 37 percent of the preventable malocclusions was due to premature loss of primary teeth.[1]

Charbeneau[7] observes that in his experience almost twice as many extractions occur in the mandible as in the maxilla.

Space maintenance is a much debated question. Orthodontists agree on the importance of study models before a retainer is made. Spencer[9] lists spaces which may need to be retained owing to premature loss of primary teeth in the order of their importance as:

"(1) Second primary molars, either maxillary or mandibular.
(2) First primary mandibular molar.
(3) First primary maxillary molar.
(4) Primary canine.
(5) Primary incisor."

He says, "The need of a space retainer depends upon the presence or stage of eruption of the succeeding permanent tooth. This information can be obtained only through the aid of the x-ray."

According to Spencer, it will be advisable generally to place a maintainer to hold the space of a second primary molar when the unerupted bicuspid has not yet progressed to a point equal to the level of the bifurcation of the roots of the first permanent molar. He concludes, too, that there is less harm through the premature loss of the first primary molars.

Cheyne and Wessels[10] state that in older children spaces do not close as rapidly as they do in younger children. They think that if a permanent molar is in an erupted position and locked into occlusion, and if the difference between the child's dental age and expected eruption of a second bicuspid is not greater than 6 to 9 months, a space maintainer would not be indicated. They confirm the statement that good cuspal inter-digitation is an aid in preventing the drifting of teeth.

Groth stated that more damage is done by the premature loss of a tooth in an arch that is under-developed: i.e. the lower arch in class II and the upper arch in class III.

Luten likes Rabinowitch's method of showing parents space maintainers are needed. He uses tongue blades cut to fit the space (Figure 17) and has parents try to fit the blade in the space periodically.

Easlick has criticized measurement standards by saying that they tend to become mechanistic, and the operator himself disregards individual patient variation.

Placement of a space maintainer should be based on (1) clinical and (2) *x-ray* examination.

Factors to be considered include:

(a) Time space must be maintained.
(b) Size of space; and size, position, and direction of erupting tooth.
(c) Occlusion in general; and the occlusion and contact of the teeth adjoining the space.

Perhaps the simplest and a relatively effective space maintainer is that commonly used and advocated by Kelner and others. He suggests fitting a Rocky Mountain stainless crown to one abutment tooth and soldering a loop to it. He says, "This appliance is very seldom displaced. Another favorable factor of this type of appliance is that it does not tie up two teeth with different anticipated exfoliative ages."

Figures 18 and 19 shows the author's technique for producing this space maintainer.

Reasons for this particular design:

A. The arms thus shaped give the retainer and the teeth adjoining the space the greatest stability.
B. The retainer opening is large enough not to impede the erupting tooth.
C. Pinch with flat nosed plier at arrow if you desire to open the space slightly—preferably just before the retainer is cemented to place.

For anterior cross-bite cases involving only one or two teeth, Waggoner recommends an acrylic bite block for the incisor region (Figure 20).

It is his experience that by this method one takes the teeth out of occlusion and opens the bite enough to give clearance without interference. He suggests that this method is quite satisfactory with 2, 3, or even 4 linguo-version upper anteriors.

Several general observations should be made in passing:

The statement probably is true that much more malocclusion is overlooked in the examination of children's mouths than is ever detected. This is because some dentists neglect one small detail: the examination of the child's teeth when they are in occlusion. Anteroposterior malrelations will be missed entirely unless the teeth are examined when in occlusion.[11]

FIG. a

FIG. b

FIG. 17. (a) Tongue blade cut to fit space of lost primary molar, (b) Tongue blade cut to fit space of a primary molar on the left side and one on the right.

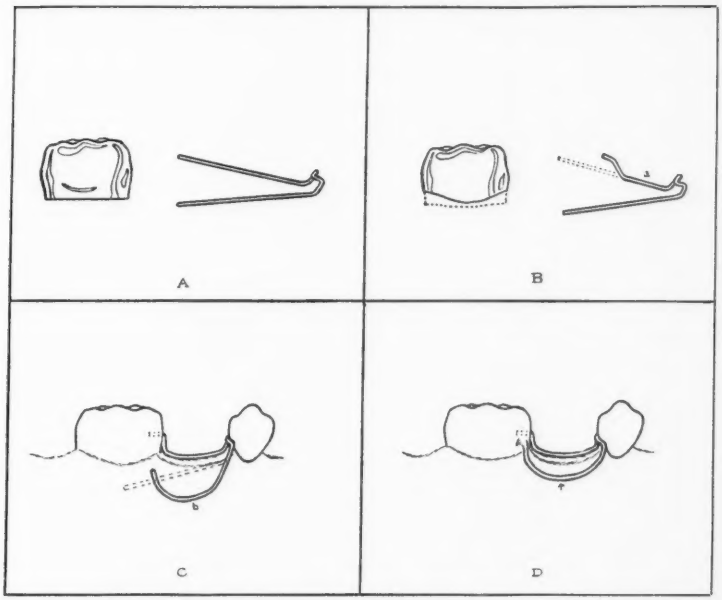

FIG. 18. Steps in producing a simple, quickly fabricated, space maintainer

A. Prepare a chrome crown and select a prefabricated 25 gauge wire. (Rocky Mountain, or prefabricate it yourself and have it on hand). Anneal the wire (heat to intensity to remove all springiness).

B. 1. Lay wire in open space, mark one arm (a) (lingual on lowers, labial on uppers).

C. Bend into space and along gum line. Soldering arm (a) to band. Contour other arm as illustrated.

D. Adapt arm (b) to tissue. Solder (b) to band. Make final adaptation of wire to tissue, polish and cement.

In regard to the relation of occlusion to normal speech, estimates have been made that between 80 and 90 per cent of the people who lisp also have a malocclusion.[12, 13] This is not surprising in view of the finding of Simon, director of the speech clinic of Northwestern University, who said recently, "In one minute of conversation at average speed, the tongue is involved in eleven hundred to twelve hundred movements." In this respect Easlick's following statement is of interest, "Bloomer (speech therapist) of our cleft-palate department has reasonably good evidence that teeth rarely are an etiological factor in speech problems. The tongue can accommodate to either alveolar bone or teeth in a person emotionally adjusted."

Once the roots of all primary teeth are completely formed, at about the age of $3\frac{1}{2}$, the transverse and longitudinal arch dimensions remain practically unchanged until the permanent teeth appear, provided that no pathologic conditions interfere with normal development.

FIG. 19. Intra oral view of the space maintainer

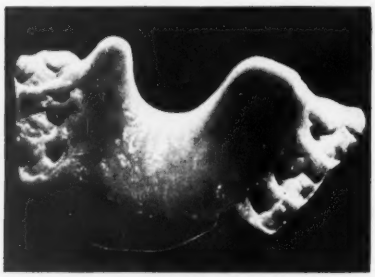

FIG. 20. An acrylic bite block

An interesting study by Brodie of growing children is worthy of consideration. It was found that the lower six year molar is strikingly constant in its relation to the mandible. "Regardless of age, the distance of this tooth to the posterior border of the ramus and to the lower border of the body always yielded a 3 to 2 ratio. The second primary and first and second permanent molars erupt at an identical distance from the border of the ramus."

Marshall[14] reports:

(1) "Children with hereditary malocclusion tendencies begin to erupt their permanent teeth earlier and finish the process later than do children with normal occlusion.

(2) The first permanent tooth to erupt in the malocclusion group is usually the lower central incisor, while in the normal occlusion group, the lower first molar is the first to erupt.

(3) The eruption of the upper permanent molar precedes that of the lower first permanent molar in the malocclusion group, while the reverse is true with the normal occlusion group."

Easlick asks the question, "Contrary to Marshall's report, is not the order of eruption of the different teeth in the two arches the important determinant?"

Marshall concludes:

"This brings out the importance of noting the sequence of eruption of the permanent dentition and should prove of great value in the predetermination of malocclusion at an early age so that the most desirous and adequate treatment plan may be formulated."

Two last orthodontic questions of particular importance to the general practitioner are: (1) Should treatment be "early or late"? (2) Is extraction of healthy teeth a commonly accepted practice in orthodontics?

There is general agreement in orthodontics that conditions which interfere with normal growth and development should be treated early; i.e. some malposed incisors, cross-bites, class II and class III conditions, etc. There is a growing tendency to wait somewhat longer with crowded class I conditions and prospective growth problems.

Oliver states:

> "Malocclusion in the majority of cases becomes apparent between the ages of 2 and 8 years—the fine order or balance is most frequently disturbed at this time—it is better to lend aid then, rather than wait for more serious complications to ensue."

Haberle agrees:

> "The archaic and unfortunately poor advice, 'Let things alone until all the permanent teeth are present', and, wait and Nature will take care of it; is still being given."

Fisher adds, "Much mischief is done by *watchful waiting!*"

Humphrey concludes:

> "Malocclusion should be corrected as soon as discovered. Earlier discovery and treatment would surely greatly reduce the large number of horrible examples of malocclusion."

Regarding the question of extraction of teeth for orthodontic purposes, in a recent survey made among orthodontists, the procedure of serial extraction was favored by a majority who replied. The basic reason for much of this extraction in orthodontics is this as Brekhus, Henry, and others have pointed out:[15] The molar teeth have not become reduced in size to accommodate themselves to the genetic shortening of the jaws which has taken place in the course of human development. Thus we may have disproportionately large teeth in a small jaw. Brekhus adds, "This disrelation becomes still more accentuated if occurring in individuals of certain constitutional pattern."

It is quite amazing what an enormous reduction has taken place in the jaws.

> "Only two figures need be recapitulated: The Heidelberg jaw surpasses the modern one in length by 40 per cent, in thickness by 50 to 100 per cent.[16]
>
> Since we cannot change the habitus of the patient, we have only the other possibility left: to adapt the denture to the patient by reduction. We have seen that Nature herself has chosen this path, but Nature has not yet succeeded in creating a satisfactory balance.
>
> On the contrary, if we look at the problem from an evolutional point of view, we shall realize that recent man's mouth is a battleground where evolution just now is waging a fierce campaign."

With this in mind Grieve writes:[17]

> "Twenty years ago I decided that in some of these cases it was advisable, in treatment, to remove all four first premolars; and as time went on, the percentage increased where we felt this procedure was indicated. For many years extraction was criticized more particularly by graduates of the Angle School. This opposition, however, has now pretty well disappeared, ... "

Actually it appears that under Tweed's leadership, supported by Strang, there are members of the Angle School who have come forward as proponents of extraction in orthodontics.

> "Normally, the best and the generally accepted procedure is to extract the first premolars. But if second premolars are decayed or already have extensive fillings, then they should be extracted. The same holds good even of first molars, though by this way, the treatment may become a prolonged one. But it is better to have this long treatment, at the end of which the patient will have a balanced denture all his own, than to insert prosthetic work so early in life."[16]

Should the general practitioner be inclined to extract for orthodontic reasons, when the advice of an orthodontist is not available, it may be well to caution against removal of reasonably healthy permanent incisors or canines *under any circumstances.*

This statement by Dewel,[18] is of interest in regard to crowded jaws:

(1) No new bone of consequence in the anterior portion of the mandible is laid down by apposition after the age of 6;
(2) internal expansion by interstitial growth in this region is impossible; and
(3) *arch length to the first permanent molars tends to decrease rather than to increase on the interchange of teeth between the mixed and permanent dentitions.*

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Pedodontics—The Field for Interceptive and Preventive Orthodontics*

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THE fields of pedodontics and orthodontics are closely allied because both deal primarily with children and youth, and because of the close interrelation of many of the problems treated. Willett[1] stated, ". . . .children's dentistry is so closely related to orthodontia that the weakness of one will readily afford the etiologic conditions which will eventually complicate action in the other". Nash[2] restated this when he wrote, "Good orthodontic practice can only exist to the degree that it is supported by good children's dentistry". In many ways, pedodontics can affect the incidence and severity of a multitude of orthodontic problems. Elaboration of this point shall be the central theme of this paper.

If preventive orthodontics is to be a significant factor in patient care, it must originate with the child patient. Pedodontics, therefore, must constantly think in terms of preventive orthodontics, as preventive or interceptive measures must be utilized at an early age for maximum effectiveness. Even orthodontic problems that are not based, for example, simply upon space loss, may be influenced by the adequacy or inadequacy of early dental therapy. Pedodontics, by virtue of the limitation of its scope of activities to the childhood population, is in position to practice preventive orthodontics as is no other branch of dentistry, including orthodontics. As a rule, pedodontics deals initially with the child at a far younger age than does orthodontics. The orthodontist seldom is in contact with the child until an obvious orthodontic problem exists. This is not meant as a criticism of orthodontic practice, for with the limited number of orthodontists, certain limitations must be placed upon their time, and it would seem that the very specialized skills of the orthodontist should be utilized in the treatment of the more complex malocclusion problems. In addition, parents seldom recognize conditions which might lead to orthodontic problems, the question of dental caries usually being the basic reason for bringing the child to the pedodontist or the general practitioner of dentistry. Preventive orthodontics, therefore, must primarily be the responsibility of non-orthodontists. This concept has been expressed numerous times before.[3,4,5,6,7]

Preventive orthodontics should be concerned with many problems related directly or indirectly with the child's oral cavity. Some of these admittedly are vague in their ultimate relationship to the presence or absence of future orthodontic problems. Some are definite and easily demonstrable in their orthodontic implications. The statement of Thomas[3] that the prevention of dental and oral disease should begin during pregnancy, and

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that of Waugh to the effect that preventive orthodontics should logically begin at the time of conception, are undoubtedly true, but the practical application of this concept relative to prevention of future oral problems is difficult. Post-natal influences upon occlusion and facial growth are easier of definition and are much more readily apparent.

It is difficult to define the "simple" or uncomplicated preventive orthodontic case. Higley[9] stated the problem very well when he wrote, "While much can be done by the general dentist, it is not assumed that all preventive treatment is simple in nature. In fact some of it takes more fundamental knowledge of growth and etiology and considerably better judgment and skill than does corrective orthodontics". This, therefore, poses the question, where does the pedodontist, or the general practitioner practicing for children, stop, and the orthodontist begin? In other words, what is the scope of preventive orthodontics for the non-orthodontist member of the profession?

Over the years, countless papers have been written concerning preventive orthodontics. Most of these papers have dealt only with prevention of premature loss of the primary teeth, with subsequent space maintenance procedures, or habit elimination, as the only aspects of preventive orthodontics worthy of detailed consideration, and have not dealt with the fundamental orthodontic principles relating to the practice of dentistry for children. As a result, application of these principles in practice has lagged, with failure of achievement of the goal of preventive orthodontics.

Responsibility of Pedodontics

Pedodontics, or dentistry for children, encompasses all aspects of dentistry; oral surgery, operative dentistry, prosthetics, endodontics, periodontics and orthodontics. The pedodontist, therefore, might be defined as a general practitioner for children. The responsibility of the field of pedodontics in preventive orthodontics may be summarized as follows:

1. Maintenance of a healthy primary and young permanent dentition by prevention and treatment of dental caries, for the provision of normal function.
2. Detection, observation and correction of oral habits.
3. Observation and guidance of the interchange of dentitions relative to time and sequence.
4. Provision for adequate space for permanent tooth eruption, through prevention of space loss following premature loss of primary teeth, and restoration of space previously lost through tooth migration.
5. Interception of ectopic eruption.
6. Management of problems of aberration in number of teeth.
7. Management of dental malformations.
8. Dietary counsel for the child.
9. Evaluation of general health status of the child.
10. Recognition of potential orthodontic problems, not included in the above categories.

It is obvious from this listing that this responsibility is not exclusively that of the pedodontic specialist, but must also be shared by all dentists who include children in their practices.

Lamons[6] has divided malocclusion cases into two general categories based upon etiology. The first includes cases of malocclusion resulting primarily from local mechanical disturbances, directly influencing tooth position. The second includes malocclusion resulting from deficiency of

growth and development of facial bones. Cases falling in the first category would definitely fall within the province of preventive orthodontics if they were seen before development of the malocclusion. Salzmann[10] states that anomalies of tooth arrangement attributable to post-natal environmental or local causes, are largely preventable, and they predominate in early childhood. This category closely parallels the first category established by Lamons. It may be noted that seven of the ten points of pedodontic responsibility in preventive orthodontics, listed above, are concerned primarily with local mechanical disturbances. This would appear to be a logical criterion for determining division of treatment responsibility between pedodontics and orthodontics, and thus establishes the relationship of pedodontics to preventive orthodontics.

If preventive orthodontics is to be a reality, it is important that the child be initially examined at a very early age, and then recurrently seen during the childhood period. Prevention of dental caries, for example, in an effort to prevent premature primary tooth loss with concurrent loss of function, can be accomplished only if the child is seen prior to the development of carious lesions. The maintenance of a caries-free dentition is probably one of the most important measures relative to preventive orthodontics. The best restoration is but a substitute for the sound, caries-free tooth, and certainly does not allow for the ultimate functional ability of that tooth. The institution of caries-preventive measures at an early age should assist in decreasing the incidence of future malocclusion related to decrease in dental arch length.

Maintenance of a healthy dentition, either through caries-preventive measures or through dental restorative procedures, is of vital importance in the maintenance of function of the dentition. It is common in a pedodontic practice to see children with a history of persistent refusal to eat resistant foods, particularly meat and raw vegetables. Examination of the mouth often reveals wide-spread caries and perhaps several missing teeth. the cause of such refusal of foods is often the child's inability to masticate adequately and without pain.

There is evidence to indicate that function of the dentition influences growth of the maxillary and mandibular structures. Watt and Williams[11] show significant difference in the growth and development of the mandible and the maxilla of the rat under experimental feeding conditions utilizing resistant vs. soft diets comparable in all other respects. This study lends considerable support to the concept advanced by Willett[12], Waugh[7], Higley[13], and others[14, 10], that function of the dentition of the child influences, in some measure, growth of the jaws. Manly and Braley[15] have shown in experiments utilizing adult subjects that decrease in the number of functioning elements in the dentition decreases the overall functioning ability of that dentition. One might postulate, therefore, that such subtraction of teeth in the child's dentition might result in a certain degree of decreased growth. Brandhorst[16] states, "In order to promote normal growth and development of the face, every tooth should be retained its full span of time, but no longer, and during that period should have the advantage of its full anatomic form. The amount of disturbance in the development of the arch is directly proportionate to the amount of tooth substance destroyed".

Thus the need for either maintenance of a full complement of healthy teeth, or

restoration of diseased teeth to correct form. The prevention of tooth loss, therefore, becomes a matter of more importance than merely one of space maintenance. Studies done in the field of prosthetics have shown that prosthetic appliances do not provide as efficient function as the natural teeth. Klaffenbach[17] demonstrated a marked reduction in poundage registration in dynamometer tests of individuals wearing artificial dentures. Reduction was also noted in fixed and removable bridge cases. Such would theoretically, be the case with a space maintainer in the mouth of a child, particularly since most space maintainers that are currently utilized are not functional. They provide for space maintenance, but usually do not provide any degree of masticatory function. Admittedly, in itself, the loss of one tooth might not contribute markedly to a significant decrease in function, thus to a decrease in growth potential, but added to other factors which might be operative in a particular child, might result in a demonstrable growth decrease. Pedodontics particularly, must pay increased attention to function of the dentition, and must provide maximum function in anatomically-correct restorations and functional space maintaining appliances.

Anatomically correct restorations are of considerable importance, as cuspal occlusion could conceivably influence the physiologic pattern of facial muscle function, and thus secondarily influence the development of abnormal facial development through abnormal muscle function. It has been postulated by Rogers[18] that muscular function may be a factor in determining stability of occlusion after orthodontic treatment, therefore, it would be logical to assume that muscle function might well influence the facial development and the development of occlusion. Salzmann[19] states "Muscular pressure and the directing guidance of the teeth are particularly influential before and during tooth eruption and in maintaining effective and normal occlusal relations of the jaws and teeth in the growing child". Stimulation of function should also be attempted through dietary advice, as it would appear that the most efficacious form of myofunctional therapy would be the normal, vigorous use of the teeth in mastication. Prescribing dietary constituents necessitating vigorous mastication, thus, stimulation of muscle function, certainly should assist in achieving maximum function of the dentition, and should be a factor in development and maintenance of normal occlusion insofar as the size of the jaws and teeth permit.

Willett[12] early pointed out the importance of space maintenance as a significant preventive orthodontic practice, and stated that in a group of 1000 orthodontic cases, caries, defective restorations and premature loss of primary teeth was the direct cause of the malocclusion of 8.4% of the cases, and a contributing cause in 52.5%. Other investigators[20, 21, 4] have emphasized the importance of maintaining space for the permanent successors, and although several advance the idea concerning the influence of a full dentition upon growth, the use of strictly functional space maintainers to enhance this growth possibility has not been stressed. Decision concerning the use of space maintaining appliances must be made on an individual basis as cautioned by Cheney[4]. Certain cases involving premature loss of primary teeth are complicated by more generalized orthodontic problems which possibly might be aggravated by space maintenance therapy. From the standpoint of function, however, it would seem wise to

utilize space maintaining appliances, at least in all cases of premature tooth loss without other orthodontic complications. It would seem wise for pedodontics to review and appraise its space maintenance technics, to determine if the appliances in current use are satisfying all the requirements of such an appliance, including the restoration of function.

Of extreme importance in a consideration of preventive orthodontics is the period of the beginning of the mixed dentition. Waugh[7] emphasized the importance of this period because of the complex relationship of the many erupted and nonerupted teeth. Pedodontics must be concerned with guidance of the interchange of dentitions of the child. *The proper time and sequence of exfoliation of the primary teeth appears to have influence upon the occlusion of the permanent dentition.* It is the responsibility of the children's dentist to observe the child patient during the periods of interchange and to intervene when it appears that exfoliation of the primary teeth is retarded. This involves careful appraisal of the child's stage of dental development. Closely allied with primary tooth exfoliation is the problem of guidance of eruption of the permanent successors, particularly the first molars, the incisors, and the cuspids. Ectopic eruption of these teeth should be detected early and interceptive treatment instigated before extensive aberration of eruption has occurred. Extraction of a second primary molar in the case of pronounced mesial migration of the erupting first permanent molar, with insertion of a spur-type retainer is an example of this type of intervention as a preventive orthodontic measure. Thorough analysis of cases of this type is necessary as this condition often indicates generalized space inadequacy, thus a potential generalized orthodontic problem.[22] Needless to say, maintenance of a healthy, functional dentition during this period is of prime consideration.

Gottlieb[23] pointed out that even the slightest obstacle may stop eruption, a very significant observation from the standpoint of the present discussion. Intervention, therefore, in the case of ankylosed primary molars, and other obstacles to normal permanent tooth eruption, becomes a pedodontic problem of considerable importance in consideration of the preventive orthodontic aspects of the case.

The emphasis in pedodontics upon early visits of the child to the dentist, makes it possible to detect, observe and if necessary, assist in timely elimination of persistent oral habits which might be contributory or causative of dento-facial deformity. Consideration of oral habits: thumb and finger sucking, tongue thrusting, lip biting, etc., is frequently a pedodontic problem. Although it has been demonstrated that there is often spontaneous correction of the malocclusion resulting from habits, after they have been eliminated, this does not decrease the importance of careful study of such cases prior to the beginning of the mixed dentition, with judicious intervention if spontaneous elimination of the habit appears unlikely.

Evaluation of the dental developmental pattern of the individual, the position of unerupted teeth, congenital absence of teeth, supernumerary teeth, dental malformations, etc., and also essential early considerations from the standpoint of preventive orthodontics.

Pedodontics, also closely allied with pediatrics, is in a favorable position to at least grossly appraise general health and growth and development of the young

child, thus assisting in the general health care of the child through advice and possible referral to the pediatrician. The pedodontist can suspect and instigate investigation of possible endocrinopathies or nutritional problems that might affect growth, or other systemic problems such as allergies, gastro-intestinal disturbances, etc., which might influence oral and facial habits, thus indirectly contributing to dento-facial problems. This may be considered as very basic preventive orthodontics.

Educational Requirements

With the eventual reduction of incidence of childhood dental caries to a manageable level, the field of pedodontics will be able to assume increasingly more of the load of preventive orthodontics. It shall be the obligation of the schools of dentistry to adequately prepare the student so that he may be in position to assume this responsibility to his patients.

It is important that close liaison be maintained between the orthodontic and pedodontic departments of the colleges of dentistry in order that students at both the undergraduate and graduate level have an understanding of the influence of adequate dental care upon the ultimate functioning of the dentition. Waugh[7] states that orthodontic training at the undergraduate level should be confined to preventive orthodontics. This appears to be a very practical suggestion, but does, however, imply the training of the student in certain fundamentals basic to the recognition of abnormality relative to malocclusion, growth, etc. Ross[24] states that an intelligent approach to dentistry for children is impossible without at least an academic understanding of orthodontics. Obviously, the ultimate or the ideal solution would be to train orthodontists and pedodontists that they could practice pedodontics and orthodontics in a joint practice as proposed by Lamons[25]. There are certain practical considerations relative to this, however, which make the plan generally unfeasible.

It seems imperative that pedodontic education at the graduate level be closely allied with orthodontic training. Some basic courses such as facial growth, growth of the child, orthodontic diagnostic procedures, etc., should be common to both areas of specialty education. If the pedodontist is to practice intelligently preventive orthodontics, his educational preparation must be adequate. Training must emphasize basic fundamentals relative to normal growth and development and to the developmental course of malocclusion, rather than appliance construction and manipulation. Salzmann[5] states, "To consider the preventive problem in orthodontics as limited to the construction, application, and manipulation of space retainers and other such appliances . . . is to revert to the mechanistic stage of dentistry prior to the twentieth century." The pedodontist must, of course, possess the necessary skills required to handle preventive orthodontic appliances, but this is secondary to basic knowledge of the problem. Recognition of incipient as well as fully developed orthodontic abnormality is basic in preventive orthodontics. It must be learned in the colleges and should be a teaching function of the orthodontic departments.

There appears to be only one danger in the non-orthodontist practicing preventive orthodontics, and this, it would seem, applies chiefly to the use of appliances; namely, that without a thorough knowledge of normal development and without an adequate ability to recognize major orthodontic problems for referral, pre-

ventive treatment might actually be contributory to further orthodontic problems in the child.

Summary and Conclusions

Of all specialties of dentistry, pedodontics should be the best equipped to assist the specialist of orthodontics in interceptive treatment. The pedodontist with an adequate orthodontic background and the opportunity to see and study countless small children, is in position to detect mal-development and to either institute interceptive therapy or to seek consultative assistance from an orthodontic colleague. Many cases of early orthodontic interest are referred to the pedodontist by the general practitioner. These cases often fall into the classification of preventive orthodontics. Some, however, are already candidates for extensive orthodontic therapy. The children's dentist must recognize this and refer such cases to the orthodontist. Cheney[4] feels that because of the great need and demand for orthodontic services, the pedodontist must recognize and do something about interception of malocclusion at a time when the greatest amount of direction can be given with the least amount of effort. He advised the examination of all children for occlusal disturbances which might promote unsatisfactory patterns of growth. This advice is all to seldom followed. In the dentist's preoccupation with restorative procedures for the teeth, the occlusion is often forgotten.

An entirely new philosophy of treatment must be evolved for the children's dentist. It must be based upon prevention in all its aspects. Preventive orthodontics can, and must, be a most important phase of this philosophy. It must be made a fundamental part of the practice of dentistry for each child. Examination of the child dental patient should include more than a mere tabulation of dental caries. Consideration must be given to growth of the facial structures and occlusion of the teeth prior to the institution of any dental therapy. Treatment of a single tooth must be considered in the light of the entire dentition. All of the aspects of preventive orthodontics must be kept in mind both during examination and therapy for the child, realizing that a multitude of factors influence the eventual orthodontic status of the individual. Those factors amenable to change, elimination or development, fall in the province of the field of pedodontics.

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The Superiority of Topical Application of Stannous Fluoride on Primary Teeth

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PREVIOUS clinical studies (1, 2, 3, 4) have indicated that stannous fluoride is more effective than sodium fluoride as an anticariogenic agent when applied topically to permanent teeth. The literature reveals, however, little attention to the inhibitory value of the topical appplication of fluorides on primary teeth. Cheyne (5) applied a 0.05 per cent solution of potassium fluoride to the primary teeth of 27 children 4½ to 6 years of age. After one year, he reported a 50 per cent reduction in carious lesions when compared to a control group of 19 children. However, since the number of subjects was so small, little reliability can be placed upon the reported degree of effectiveness. Jordan (6) in a more extensive study, involving over 900 children, studied the caries inhibiting effect resulting from the application of different numbers of sodium fluoride treatments on primary and permanent teeth. The results following 1, 2, or 3 applications were 4.9, 14.5 and 40 per cent less caries respectively in the primary dentition. The inhibitory effect seemed to have a tendency to be more pronounced for primary than permanent teeth in the group receiving 2 or 3 applications. Ast (7) applied a 2 per cent sodium fluoride solution to one-half the mouth of 260 children and reported a 22 per cent overall caries inhibition as compared to the untreated side. Wittich (8) studied 40 children with the half-mouth technique and also noted a 22 per cent reduction in the incidence of caries with sodium fluoride. Sundvall-Hagland (9) recently reported a study in which 209 children with a median age of 2 years 8 months were observed at 1, 2, and 3 year intervals. 107 children received 4 applications of a 2 per cent sodium fluoride solution, and a caries inhibition of 19 per cent for the first year, 14 per cent for the second, and 9 per cent for the third year was reported. The teeth which were carious at the time of the fluoride treatments were unaffected.

Galagan (10) studied the effect of topical fluorides on the teeth of 350 children, 7 to 16 years of age, which matured in an area containing natural fluorides in the water. A series of topical applications of a 2 per cent solution of sodium fluoride resulted in a 9 per cent reduction in the dental caries incidence.

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MATERIAL AND METHOD

300 children who came to the Indiana University Pedodontic Clinic were selected at random. Since a study of the effectiveness of topical fluoride application to the primary teeth was the purpose of this work, children were selected who would in all probability retain their primary teeth for at least a 2 year period. The group was further limited to those who resided in the Indianapolis area where optimum fluoride had been in the water for a period of 3 years. All of the

children were exposed to the topical effect of fluoride from the communal water of Indianapolis prior to and during the observation period. The clinical examinations and the recording of the caries experience in the primary teeth were performed by the same person (R.E.M.). Full mouth and bite wing radiographs were taken for all the subjects in the group at each examination period.

Group 1 received 4 applications of a 4 per cent aqueous solution of stannous fluoride which had a pH of approximately 3. Since stannous fluoride hydrolyzes and oxidizes so rapidly the stannous fluoride solution was prepared fresh for each application. This was done by adding 0.4 gm of solid stannous fluoride to 10 mls. of distilled water. Group 2 received 4 applications of a 2 per cent aqueous solution of sodium fluoride which had a pH of 7.0. Each group received a thorough prophylaxis immediately prior to the first fluoride application. The second, third and fourth fluoride applications were completed within a two week period and were not preceded by a dental prophylaxis. The teeth to be topically treated were isolated with cotton rolls, carefully dried with warm air, and the fluoride solution applied continuously by means of cotton applicators for a 4 minute period. Group 3 received only a prophylaxis and served as the control group.

Data and Discussion

Of the 300 children initially treated, a total of 227 were available for examination at the end of one year, and Table 1 shows the age distribution of these subjects. The stannous fluoride group was composed of 86 children with a median age of 6.16 years. The sodium fluoride group contained 76 children with a median age of 6.10 years. The control group had 65 children with a median age of 7.13 years. Table 2 shows the sex

TABLE 1

Age Distribution of Subjects in the Three Groups at Initial Examination

Stannous Fluoride Group		Sodium Fluoride Group		Control Group	
Age	No. of subjects	Age	No. of subjects	Age	No. of subjects
3	5	3	4	3	4
4	11	4	10	4	4
5	16	5	11	5	13
6	17	6	19	6	10
7	13	7	15	7	10
8	19	8	15	8	11
9	4	9	2	9	9
10	1	10		10	5
11		11		11	2
12		12		12	1
Total..	86		76		65
Mean Age.	6.16		6.10		7.13

TABLE 2

Sex Distribution of the Children Receiving Either the Topical Fluoride Application or in the Control Group

Group	Boys	Girls
Stannous Fluoride.....	46	40
Sodium Fluoride.....	33	43
Control.....	36	30

TABLE 3

Mean Caries Increment during the One Year Study Period

Group	Subjects	Mean total new DMF teeth	% Reduction	Mean total new DMF surfaces (on previously sound and carious teeth)	% Reduction
Stannous Fluoride...	86	0.33	57	1.79	37
Sodium Fluoride...	76	0.61	21	2.50	12
Control....	65	0.77	—	2.84	—

distribution of the three groups and indicates a fairly even distribution.

Table 3 shows the mean caries increment for the one year period in terms of the average number of new DMF primary teeth, and the total new DMF surfaces on previously sound and previously carious teeth as well as the percentage reduction compared to those of the control group. The stannous fluoride group experienced a 57 per cent reduction in new carious teeth and a 37 per cent reduction in surfaces when compared to the control group. Both of these reductions are significant; the reduction for teeth at the .001 level of confidence and the surfaces at a level greater than the 0.1 level of confidence. The sodium fluoride group experienced a 21 per cent reduction in new carious teeth and a 12 per cent reduction in new surfaces, neither of which was significant.

The stannous fluoride was significantly superior to the sodium fluoride at the 0.05 level of confidence when either the DMFT or DMFS indices were used.

While the numbers of subjects treated in this study were not extremely large, and while the program extended only throughout a single year, the data clearly indicate the superiority of stannous fluoride over sodium fluoride. It would be of interest, however, to determine the duration of effectiveness, especially if yearly or semi-annual single applications were used to augment the effectiveness of the initial treatments.

Conclusions

One year following 4 applications of a 4 per cent solution of stannous fluoride and 4 applications of a 2 per cent solution of sodium fluoride, stannous fluoride was significantly superior to sodium fluoride in the reduction of new caries in primary teeth of children.

In the stannous fluoride group there was a significant reduction in both new DMF teeth and total new DMF surfaces when compared to the control group. While the sodium fluoride resulted in numerically less dental caries, the reductions were not significant.

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Unit News

NOTICE

With this issue of our Journal we accept the resignation of Mel Noonan as Unit News editor. Mel has done a fine job and his cooperation and friendly support have meant much to us these past several years. We are sorry to see him leave our list of contributing editors, and are grateful for his help and contributions.

Our new Unit News editor is Dr. Theodore C. Levitas—Ted from now on—of 340 Boulevard N.E., Atlanta 12, Georgia. We hope your Unit officers will send publicity to Ted so that Unit News can bring our members relevant information about Unit activities.

Deadline dates for Unit News are: 3rd Q 1957, July 1; 4th Q 1957, September 15; 1st Q 1958, January 1. Material should reach Ted Levitas by the above dates.

Stimulate publicity for your Unit by encouraging your Unit officers to send information to our Unit News editor!

A.E.S.

The Oxford Dictionary defines the word "unit" as "one of the separate parts or members of which a complex whole or aggregate is composed . . ." and it further describes it as ". . . such a division or group of individuals considered as a basis of formation or administration . . ." The officers of the A.S.D.C. take this definition rather literally for without the support of the individual Units, the parent body could hardly have the strength it now possesses.

With this in mind, the staff of your *Journal* can only implore, cajole, plead, and, verily, beg for items of interest to be included in the Unit News column. Chapter officers, attend—if your Unit is missing in this issue, get something ready for next time!

And now to the news at hand.

Arkansas

Children's Dental Health Week in Little Rock was a rousing success, partly because of the large billboard posters which were displayed for the first time. In April, Unit members heard Dr. Arthur Lindquist of Kansas City speak on "Cleft Palate Procedures."

Southern California

The Southern California Unit had a bang-up meeting in May on the subject of "Oral Pathology as Related to Children." Dr. Hamilton B. G. Robinson of Ohio State Dental College was the speaker. In addition, Dr. Barney Katz, a clinical psychologist, discussed children's problems. The four day meeting was enjoyed by all and included good entertainment in addition to the scientific sessions.

Northern California

The Northern California Unit reports on two meetings. The new officers are: Dr. Haywood Norton, president; Dr. Lloyd Richards, president-elect; Dr. Ron Light, vice-president; Dr. Tom Barry, secretary-treasurer; and Drs. Gene Tenno, Lyn Rudy, and Jim Englis, directors.

Lloyd Richards recently returned from post-graduate study in Washington, and Chuck Sweet, Jr., is returning after a successful year as head man of the pedodontic department at U.S.C.

Lee Winters heads the Diablo Academy for Pedodontic Advancement which is a newly formed study group.

Editor for the Unit, Bob Burley, reports the recent earthquake out there was caused by past-president Eddy Mack falling off his wallet! Incidentally, the Unit presented Dr. Mack a plaque and gavel for a great job when his term of office ended.

(Man! That's a report and a half!)

Georgia

Things are happening down South where the Unit is hard at work preparing for its Third Annual Pedodontic Seminar which will be held shortly after Labor Day. Complete details will be forthcoming.

The City of Atlanta was literally bombarded with Children's Dental Health Week propaganda. No less than 15 radio and television interviews were granted, not to mention all the other free publicity the committee was able to garner.

Current officers for this not-too-long-ago re-organized Unit are: Dr. Ted Levitas, president; Dr. Charles Barnwell, president-elect; Dr. T. Eros, vice-president; and Dr. Mary Lynn Morgan, secretary-treasurer.

Hawaii

All the recent news from this Unit appeared in the last issue, but a list of the new officers is always in order: Dr. Manuel Kau, president; Dr. Daniel Kugiya, vice-president; Dr. Jonah Park, treasurer; and Dr. Benjamin Sherman, secretary.

New York

This state Unit listened to Dr. Edward Lusterman discuss "Dynamics of Facial Growth and Development Relative to Space Maintenance." The meeting was held in May in New York City. At their December meeting, a series of table clinics was presented. Those participating were: Dr. Irving L. Anderman, "Preventive Orthodontics;" Dr. Norman Feitelson, "Amalgam Fillings in Primary Teeth;" Dr. Robert I. Kaplan, "Dentistry for Handicapped Children;" Dr. Joseph G. Keller, "Space Maintenance;" Dr. Samuel Luks, "Endodontia from Ages 6–12;" and Dr. Arnold Rosenberg, "Diagnosis and Treatment Planning." Dr. Samuel Harris also discussed "Human Relations in Dentistry for Children."

New Jersey

Dr. Lawrence Burdge, our national president, of Red Bank, N. J., was the principal speaker at the dedication of the new building of the Camden Free Dental Clinic. This program was held in conjunction with Children's Dental Health Week.

The mid-winter meeting of this Unit in January featured Dr. Ralph McDonald of Indiana University who spoke on "Management of Common Pedodontic Problems." The afternoon session featured a series of table clinics.

Ohio

Dr. Regina David reports from Cleveland that they had another successful Children's Dental Health Week, and, "As usual," she says, "we broke our own record." Dr. Chester Schultz was presented a testimonial certificate during The Week by the Cleveland Dental Society. It is interesting to note that Dr. Schultz was president of the Ohio Unit of the A.S.D.C. when Dr. David and Dr. Norm Denner instituted the first Children's Dental Health Day in Cleveland.

A component study group of the Ohio Unit has been organized in Dayton. The first meeting was attended by 41 dentists. Officers elected were: Dr. Paul Starkey, president; Dr. Robert Doench, vice-presi-

dent; Dr. Eugene Huffman, secretary; and Dr. Robert A. Kuhn, treasurer. Dr. Lyle Pettit, head of the pedodontic department at Ohio State, discussed the history and purposes of the A.S.D.C. The May meeting highlighted demonstrations by slides and models of difficult cases various members have encountered.

These men are all interested in dentistry for children and their new study group sounds like a great idea.

Pennsylvania

The Western Pennsylvania Society of Dentistry for Children had a most interesting March meeting. Dr. R. I. Crumpton, head of the Partial Prosthetic Department at the University of Pittsburgh Dental School, discussed the latest methods of treatment for cleft palate and cleft lip, emphasizing surgery and speech aid appliances.

Because of the alarmingly high rate of cleft palate and lip involvement (one out of 800 births), the State of Pennsylvania has allotted funds to help defray treatment for indigent patients. No doubt the dentists of the Keystone state played an important role in getting this legislation through. Well done!

Michigan

The Annual Meeting of the Michigan Society of Dentistry for Children was held at the Statler Hotel April 10, 1957, with some 75 members and guests in attendance. Doctor Ralph Ireland of Lincoln, Nebraska, who had been a principal speaker at the Annual Meeting of the Michigan State Dental Association, was introduced by Dr. Ken Easlick.

Ralph did an excellent job of presenting some of the highlights of the development of the A.S.D.C. and pedodontics in general.

Retiring President Joe Cabot acknowledged the efforts and accomplishments of his co-officers and committeemen and accepted from George Guest a gold gavel in recognition of his leadership during the past year.

For the year 1957-58, the following officers were elected:

President—George Guest, Grosse Pointe

Vice-President—Wm. Graetz, Berkley

Secretary-treasurer—Zalman Konikow, Royal Oak

3 yr. Councilman—James Scofield, Jackson

1 yr. Councilman—Jos. Cabot, Detroit

Idaho

From Vernon Nord, Editor of the Idaho Unit, comes a nice report as follows:

The annual meeting of the Idaho Unit of the A.S.D.C. was held in Pocatello on May 15, 1957. Dr. Earl Lampshire of the University of Nebraska was the clinician.

The midwinter meeting was held in Boise on February 14th with 18 members in attendance.

The Idaho Unit now has 47 paid members. At present, there are only 223 members of the Idaho State Dental Association. This means that 21% of the A.D.A. members are members of the A.S.D.C. We believe this sets some kind of a record. (*Ed. note: it may not be a record, but it does deserve acknowledgment!*)

On September 27, 28, 29, 1957, the 2nd Annual Northwest Conference of Dentistry for Children will be held in McCall, Idaho, at the Shore Lodge on Lake Payette. Dr. Ralph McDonald will be the clinician.

Pan American Council of Dentistry for Children

The A.S.D.C., of course, is more properly considered a unit of the P.A.C.D.C.

since it is an official member of the Council. It is our thinking, however, that it is appropriate to include a digest of the Council's activities in this column.

In addition to the A.S.D.C., the Council has as its members the Canadian Society of Dentistry for Children and a Sociedad de Odontologia Infantil in Mexico, Panama, Cuba, Colombia, and Nicaragua, the Sociedad Argentina de Odontopediatria, and the Club de Estudios de Guatemala. Next meeting of the Council will be held in Miami in November, 1957.

For its last meeting of 1956, the Mexican Society held a symposium that included discussions of examination and x-rays, diet, topical use of NaF, inlays, amalgam restorations, steel crowns, and preventive orthodontics. That could almost be called the "compleat" program!

The Panama Society sent a delegation to a meeting in El Salvador where "they constituted the Dental Federation of Panama and Centroamerica." At this meeting there was a discussion of the use of phenylbutazone and aminopirine on children.

In March of this year, the Cuban Sociedad had as its program a symposium on Preventive Dentistry.

* * *

Our confreres around and about certainly seem to be demonstrating their interest in dentistry for children. An accolade to them.

And that does it for now. But let's have more Units represented next quarter. We want to know what's going on—and by whom. Have a nice summer.

Pulp Management for the Child Patient

MELVIN A. NOONAN, D.D.S., M.S.

INTRODUCTION

THE management of the dental pulps of children is a very complex topic with many facets. If all phases were to be considered completely, volumes could be written on this subject. Needless to say that the subjects discussed in a report of this type can only be abridged.

The pulpal tissues of human teeth can be afforded no greater protection than to prevent these tools of mastication from experiencing dental caries or trauma. If the foregoing statement is acceptable, then the greatest results can be achieved by preventive methods. As of this date, science cannot eliminate dental caries completely nor has man devised a "fool-proof" method of preventing all types of trauma. Until these damaging factors can be controlled the dental profession must strive to improve its means of protecting and preserving the health of the dental pulps.

Pulps may be damaged and even devitalized during cavity preparation, by cavity medication and by restorative materials. Improper restorations and a host of other agents can be responsible for pulpal damage.

HISTOLOGICAL CONSIDERATION

Pulpal tissue like any other tissue of the body has a definite function; the primary function of the dental pulp is the production of dentin. Other functions which can be considered secondary are furnishing nourishment to the dentin and supplying the tooth with a nervous system. The nervous system gives sensation to the tooth structure and helps to regulate the blood supply. The dental pulp is protected by the dentin wall around it but this same wall which is protective may be a liability if an inflammation of the pulp is too great.

The pulp contains defense cells and it is capable of protecting itself if the irritation or trauma is not too great. The three types of defense cells are: 1. histiocytes, 2. mesenchymal cells, and 3. ameboid wandering cells. All are capable of migrating to sites of inflammation and forming macrophages. The ameboid wandering cells may develop into plasma cells which are a cell type found in chronic inflammation. The fact that the dental pulps contain defense cells has changed the one time theory that an exposed pulp meant a lost pulp. Due to the foramen at the apex of the root it seemed logical to theorize that the blood supply to the dental pulp was limited and not enough to supply the needs of defense. Today the pulp is known to have an abundant blood supply.[1]

Histologically there is no difference between the pulpal tissue of primary and permanent teeth. There may be a physiological difference but at the present time there are no means of evaluating such a difference.[2]

PULP MORPHOLOGY

Another phase which must be considered for pulp protection, especially during cavity preparation, is the morphology of the pulp chamber. The dental pulp occupies completely the pulp chamber and root canals. The pulps of young teeth are large and have long horns ex-

tending into the cusps. As the tooth ages, the pulp is reduced in size by the deposition of dentin which makes the chamber smaller. In general terms the pulp chamber is shaped similar to the outer surface of the tooth but the mesial horns of molars are closer to the outer surface than the distal horns and therefore are more easily exposed.

Protection during Cavity Preparation

A careful consideration of pulpal tissue must be given during cavity preparation. With the advent of high speed rotary instruments, air abrasive, ultrasonic and other dental cutting procedures pulpal protection can be more complex. Local anesthetics can provide a painless procedure but can be a detriment, if the operator thinks that once pain is controlled he need not use caution. Pain is Nature's warning and a patient can relay a message of discomfort to the dentist promptly. Although the means of transmission may indicate an uncontrolled patient, it may control the operator. Local anesthetics should not be condemned but caution should be the primary interest of the operator when they are used.

There is a wide variation in the structural characteristics of teeth. The dentin in young permanent teeth is immature and highly permeable. The adult tooth has dentin which is highly impermeable.[3] In the latter case the pulp has more protection because the heat created by friction is conducted through the dentin matrix. The dentin of the primary tooth being highly permeable must be prepared with extreme care or any frictional heat can affect the fluid content of the dentinal tubules and cause pulpal irritation.

Temperature rise during cutting of tooth structure is affected by the choice of instrument, the speed and pressure of that instrument and the choice or lack of choice of a coolant. Without coolants a steel bur at 4,000 rpm will cause an unnecessary rise in temperature. At 6,000 rpm both the steel and carbide burs cause an excessive temperature rise and at 8,000 rpm or above even the diamonds produce excessive heat. Although both air and water sprays can control the temperature rise, water is much more efficient. With the coolants, speeds of 10,000 rpm will not produce excessive temperatures. A coolant should be considered essential with rotary instruments and speeds of 5,000 rpm or over.[4]

Further research is needed to establish the effects of ultrasonic and other methods of dental cutting before these can be accepted. Hansen and Nielson[5] experimenting on guinea pigs showed that by cutting with the ultrasonic method severe pulp changes and alterations in dentin formation were found; these were not present in teeth prepared by rotary methods.

Cavity Medication

It is logical to assume that all the organisms found in the oral cavity can be found in a carious lesion and it should be the objective of the operator to remove these organisms from a cavity before placing a restoration. A well placed restoration may prevent a continuation of the caries activity but the organisms left in the dentinal tubules may be dangerous. Besic[6] showed that organisms were capable of remaining in a sealed cavity for at least a year. Although his sealing with gutta percha and zinc phosphate cement may be questioned,[7] further research is needed to prove him wrong.

Much has been written about cavity "sterilization" but most of this has been empirical. One would not expect to have an aseptic chain if all instruments were just wiped with a germicidal solution, so how can it be said that wiping a cavity

can render the dentin sterile? In shallow or incipient carious lesions the proper depth for a cavity preparation may eliminate all the invading organisms; removal of the cuttings with warm water is all that might be necessary. Deeper lesions present another picture.

Silver nitrate once was thought to be capable of sterilizing dentin because it does penetrate the dentinal tubules.[8, 20] Sebelius[9] in 1942 and Fletke[10] in 1955 advocated its use. Seltzer's[11, 12] work indicates that silver nitrate was less effective than phenol. Organisms are capable of penetrating farther than silver nitrate. Its ineffectiveness also was demonstrated by Zander.[13]

It also would seem logical that in sterilizing carious dentin the medication must have sufficient time to act. Burkman[14] and his co-workers show bright prospects of sterilizing carious dentin by sealing in a thick paste of penicillin and camphorated parachlorophenol for a period of one to three weeks and then taking cultures.

It is not doubted that there are many agents that, if sealed in a tooth, could sterilize the dentin but the reaction of the pulpal tissue to the agent is of primary importance. It has been demonstrated in vitro that a zinc oxide and eugenol cement has a prolonged germicidal action when in contact with infected dentin for a period of 24 to 48 hours.[15, 16] When not placed directly upon exposed pulpal tissue, zinc oxide and eugenol are very soothing to an injured and inflamed pulp. Until further research will develop something better, it is advisable in deeply carious teeth to seal in zinc oxide and eugenol to sterilize the remaining dentin and to allow the defense mechanism of the pulp to respond.

Effect of Filling Materials

In shallow cavities the pulp tissue is well protected under metallic restorations but the zinc phosphate cements and silicate cements can and do cause irritation.[17, 21, 22, 23] The pulpal changes under the zinc phosphate cements were less severe than under the silicate cement and were reversible. In deep seated cavities a silicate cement caused a marked inflammation with celullar inflammation and abscess formation. The defensive powers of the pulp were demonstrated by having the abscess walled off and calcification of the degenerated areas.

The copper cements also are very irritating and of this group the black copper cement was the most damaging.[17, 22] Although in shallow cavities zinc phosphate cements do stimulate a healthy pulp to form secondary dentin, the zinc phosphate and copper cements should not be used as bases for deep cavities.[21, 22, 23] These materials should be replaced by a quick setting zinc oxide and eugenol cement.

Massler[17] reported that the most effective liner for the silicate cements was zinc oxide and eugenol cements with 2 to 4 percent zinc acetate but the free eugenol discolored the restoration; consequently other liners must be used. When he compared a polystyrene and calcium hydroxide liner[18] (Chembar), a calcium hydroxide methyl cellulose paste (Pulpdent) and resin based varnishes with zinc oxide and eugenol base he found them 85, 65 and 20 percent effective, respectively. Silberkweit[32] also found the cavity varnishes very ineffective.

Paynter[24] and co-workers in search of a better cavity liner experimented with thirty preparations including methyl silicone oils, alkyl silicone resins, and methylchlorosilanes. The usual inflammatory reaction to the silicate cements was not seen in pulps of teeth under cavities which had been lined with the silicone preparations prior to the filling. Their results showed that the pulp was protected from

the deleterious effects of the silicate cement when the methyl silicone resin was applied to the base of the cavities.

An excellent rule to follow is never allow a cavity to remain open and unprotected. Another rule to follow is to never use a temporary filling which is irritating. Gutta percha has been used for years as a temporary filling in spite of the fact that it is very irritating[25, 26, 27] and a very poor sealer.[7] James[26] states, "The pulp under cavities prepared and temporarily filled with baseplate gutta percha is already an inflamed pulp when the subsequent permanent filling material is placed." The zinc oxide and eugenol cements again are superior to all other temporary fillings because of their soothing and sealing properties.

The self curing resins are not in themselves very irritating to the pulp and the changes in the odontoblastic predentin area as a result of trauma caused by cavity preparation and placing the acrylic is no longer present after seven days.[28] Grossman[29] reports that he had four times the number of pulp deaths under the self-curing resins than under silicate cement which were used as controls. The deaths cannot be attributed to the irritating properties but to the poor physical properties. The marginal seal of the acrylic is very poor and leakage occurs within 24 hours after insertion.[7] The ill effects that the pulpal tissue receives under the self-curing resins are noticeable after a longer period of time. Grossman[29] also shows that a zinc phosphate cement base, a poor sealer in itself, prevented or minimized the pulpal damage produced under the self-curing resins.

Even silver amalgam shows some effects on the pulpal tissue other than thermal shock.[30, 32] In shallow cavities there is very little but in deep cavities there is a slight effect. Massler and Barber[30] showed that the mercuric ions could be transmitted through the dentinal tubules by electrogalvanic action and retard the formation of secondary dentin. This indicates that a zinc oxide and eugenol cement base should be used in the deeper cavities.

Vital Exposures

The pulp tissue has the ability to set up its own defense. If it has not degenerated beyond a certain point, it is capable of recovery and production of secondary dentin to close an exposure. McDonald[31] shows that the present day diagnostic methods of determining the exact condition of the pulps are not too accurate and better methods need be found. He also states, "The healthy pulp will survive and repair small injuries even in the presence of a few bacteria, the same as any other connective tissue. The defense mechanism should not be destroyed nor the healing process delayed by caustic chemicals or heat."

In 1941 Ogur[33] read a paper to the New York Dental Society advocating the use of pulp capping, pulpotomy and root canal therapy in primary teeth and, although some of his recommendations might be questioned, it is interesting to read the discussion[34] which followed his presentation. A professor of root canal therapy at that time stated he did not treat pulp involved primary teeth nor did he advise it. Why should an exposed pulp mean an extracted tooth?

There is no histological difference between the pulp tissue of a primary tooth and that of a permanent tooth.[2] They both are capable of offering their own defense and producing secondary dentin. Until more accurate diagnostic means can be developed to determine the exact state of the pulps there will be failures but this should not discourage one from attempting to save an exposed pulp.

Although there are many claims for all sorts of medication to an exposed pulp,

Englander and co-workers[36] have indicated that "sedation of the pulp, sterilization of the dentin prior to amputation and a careful operative technic are probably more important to clinical success than the type of calcium salt or antibiotic employed to cover the amputated pulp."

Current literature is divided as to the success of certain materials used on exposed vital pulps. At present the most popular and widely used material for exposed and amputated pulpal tissue is calcium hydroxide. Zander[37] in 1939 stated, "Inorganic content of dentin is primarily a hydrated tricalcium phosphate and as such should follow the laws of mass action in relation to the solubility product. The blood is normally saturated or supersaturated with Ca and Po^4 ions, and hence any increase in Ca and Po^4 would cause a precipitation or laying down of calcium salts. A material which contains either Ca or Po^4 in a combination which would be easily ionized when brought in contact with the surface of the pulp should react in this manner. This probably is the action of calcium hydroxide."

The success[38, 39, 40, 41] and lack of success[42, 43] of the vital pulpotomy have been published. The conclusions drawn from the results can be affected by one's accepted criterion for success. Via[42] considered the lack of radiographic evidence of a dentin bridge as failure. Brinsden[44] was able to demonstrate more dentin bridges clinically than radiographically. Shoemaker[44] reported only 39 percent success using calcium hydroxide and bone meal. His technic was aseptic but he used zinc phosphate cement which has very poor sealing properties to close the cavities. If a tooth is worth the time and trouble of a pulpotomy, it warrants a permanent restoration which should be placed at the same time.

Via[45] has demonstrated that dentin bridges could be produced on pulpotomized teeth without using calcium ions. Using inert barium sulfate as a capping on dental pulps of monkeys, he was able to produce dentin bridges without any evidence of inflammation. He also used a mixture of Grossman's polyantibiotic mixture plus barium sulfate and again demonstrated dentin bridges without any inflammation to the remaining pulpal tissue.

Seelig[46] and co-workers demonstrated normal pulps and dentin bridges after treating amputated pulps with a paste made of penicillin and calcium carbonate. Their work also contra-indicates the use of zinc oxide and eugenol as a capping or over amputated pulps. When in direct contact with the pulp it produces abscess formation and resultant liquefaction.

The choice of pulp capping or pulpotomy depends upon the amount of pulpal tissue exposed. The smaller the opening the greater the chance of success with the pulp capping. Massler[35] has done a fine job of organizing some general rules for handling teeth to undergo vital pulpotomies. Some of these same rules also can be used for pulp cappings. He does not advocate amputation on the first visit but rather sedate the pulp and sterilize the dentin before amputating. The dentin bridges that are formed when the amputation is done on the first visit and covered with calcium hydroxide were acceptable clinically but from a histopathologic point of view better results were obtained if the amputation was done after the pulpal tissue was sedated and the remaining dentin sterilized.

Surgical trauma should be avoided and bleeding should be active. A thin blood clot should be allowed to form and remain undisturbed. The capping material should be dusted over the stumps and covered with zinc oxide and eugenol cement. Zinc phosphate cement should not be used over the calcium salt or other capping material

for fear that the acid may leak through and destroy the vital tissue. Zinc phosphate cement may be used on top of the zinc oxide and eugenol cement and then the permanent restoration should be placed.

Summary

Histologically there is no difference between the primary and permanent pulp tissue.[2] Both are capable of offering their own defense and under favorable conditions will produce a barrier of dentin as protection from irritation. The blood supply to the pulpal tissue is abundant[1] and repair of this tissue is much like any other connective tissue.[31]

In order to protect the pulpal tissue especially during cavity preparation the general morphology of the pulp chamber must be kept in mind. Also during cavity preparation caution must be used to prevent the dental tissues from excessive heat.

When speeds of 5,000 rpm or over are used with rotary instruments a coolant is essential and the water spray is the most efficient. Some of the results of preliminary research[5] done on the effects of other methods of dental cutting have not been too favorable and further study is needed to either validate or discourage their use.

Cavity "sterilization" has been the topic of much of the literature but most of the articles are empirical. To protect the pulpal tissue it would be ideal to sterilize the dentin over the pulp; this cannot be done merely by wiping a drug on a cavity floor. In shallow lesions the cavity preparation may be deep enough to leave only sound and uncontaminated dentin. In deeper cavities, and especially those approximating the pulp, the drug used should be sealed in to be effective. Zinc oxide and eugenol have germicidal and abirritant properties.[16] Promise has been shown by sealing in a paste made of penicillin and camphorated parachlorophenol.[14]

Zinc oxide and eugenol cements not only are soothing to the pulp but have better sealing properties than the others. Using zinc oxide and eugenol cements as liners for silicate cement and self curing restorations will result in discoloration so other liners are necessary.

Base plate gutta percha and temporary stopping have poor sealing qualities and are very irritating to the pulp and should not be used as temporary restorations. The self curing acrylic resins have poor sealing properties and although not irritating to a pulp to any noticeable degree a base is necessary.

Silver amalgam besides transmitting thermal shock is capable of irritating pulpal tissues in deep cavities[30] and should be placed over a zinc oxide and eugenol base or a cavity liner in less deep cavities.

If the pulpal tissue has not degenerated beyond a certain point, exposures can be handled so that the pulp will remain vital. The exact state of the pulp cannot be determined with present day pulp testers or radiographs[31] and until more accurate means are developed there will be failures. Small exposures may be handled by pulp capping and those with larger involvements need pulpotomies. Today the material most commonly used over amputated pulps is calcium hydroxide but some studies show dentin bridges formed without the calcium ions being present.[36, 45] When pulpal tissue is cariously exposed the results of the pulpotomy are better if the dentin can be sterilized and the pulp sedated before the amputation is done. Caustic drugs should not be used and a blood clot should be allowed to form over the exposed surface of the remaining pulp tissue.

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A Report of Supernumerary Teeth in Houston, Texas School Children

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THE incidence of supernumerary teeth in the public school population of Houston, Texas is believed to be unusually high. The six cases presented here were the first treated cases of supernumerary dentition brought to the attention of the Houston Health Department Dental Clinics by school health personnel. Further studies are now in progress, and it is expected that within one year sufficient cases will have been treated and recorded to present a statistical report of the conditions observed and the incidence of supernumerary dentition in school children.

CASE I

Male, 8 years old, Latin-American*, presenting two well-developed supernumerary teeth: one anterior between the maxillary permanent central incisors, the other in a palatal position (I_a, I_b). Radiograph (I_c) shows the anterior tooth clearly and the palatal tooth superimposed upon the right permanent central incisor. Extracted 5–22–56, the anterior tooth measured 17.5 mm. in length and exhibited basic peg formation with aberrant lingual anatomy; the palatal tooth measured 16.5 mm. and was a classic peg shape (I_d Palatal tooth on the left, anterior tooth on the right).

* The use of this term locally refers to those of Indian-Mexican or Indian-Spanish descent.

CASE II

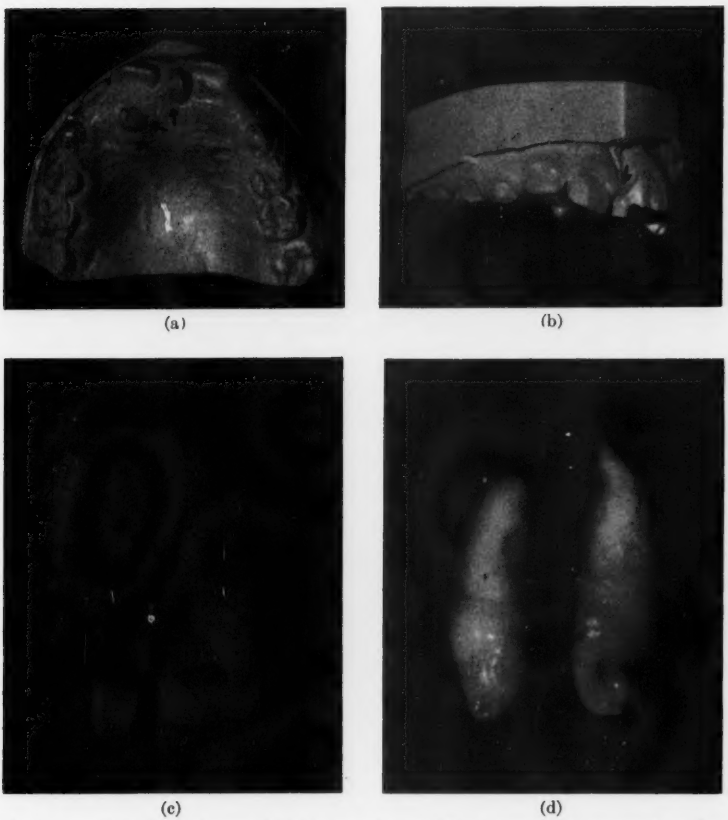
Male, 8 years old, Caucasian, presenting a peg-shaped supernumerary tooth between the maxillary central incisors, preventing normal alignment of the permanent dentition (II_a, II_b). Maternal great-aunt reported to exhibit the same condition. Radiograph (II_e) shows caries involvement and incomplete root formation. Extracted 5–29–56, this was the smallest supernumerary tooth (12 mm. in length) of the pilot cases and was the only tooth exhibiting extensive incisal wear and carious lesion (II_d).

CASE III

Female, 10 years old, Latin-American, presenting a well-developed supernumerary tooth located lingual to the maxillary permanent central incisors, displacing the right central incisor to the labial (III_a, III_b). Radiograph (III_e) shows the tooth to have fully developed root structure and to be independent of the adjacent right central incisor. Extracted 5–8–56, the tooth measured 17 mm. in length and exhibited typical supernumerary peg shape (III_d Mesial View).

CASE IV

Male, 9 years old, Latin-American, presenting a large, aberrantly-formed supernumerary tooth between the maxillary permanent central incisors, forcing the right central incisor into a labial posi-



(a) (b)

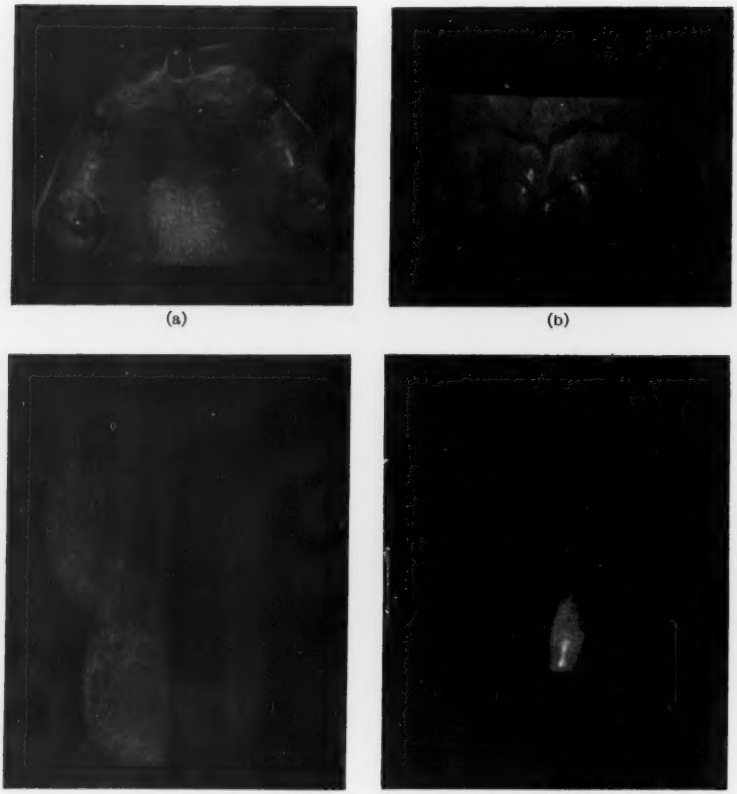
(c) (d)

FIG. 1. Case I. (a) Palatal view; (b) labio-buccal view; (c) radiograph; (d) extracted teeth.

tion to the lateral incisor (IV_a, IV_b). Radiograph (IV_c) shows the overall size of the tooth in comparison with the permanent dentition. Extracted 5–22–56, the tooth measured 21 mm. in length and exhibited coronal decalcification and a ring of green stain (IV_d Distal View).

CASE V

Male, 10 years old, Latin-American, presenting a well-developed "cuspid-shaped" supernumerary tooth mesial to the maxillary left permanent central incisor, inhibiting eruption of the right permanent incisor which erupted 2 months after extraction of the supernumerary tooth (V_a, V_b). Radiograph (V_c) shows the manner in which the supernumerary tooth blocked eruption of the right central incisor. Extracted 5–22–56, the tooth measured 20 mm. in length and exhibited developmental grooves on the labial and lingual surfaces of the crown (V_d).



(a) (b) (c) (d)

FIG. 2. Case II. (a) Palatal view; (b) labial view; (c) radiograph: (d) extracted tooth.

CASE VI

Male, 7 years old, Latin-American, presenting a well-developed, peg-shaped supernumerary tooth between the maxillary primary central incisors. The left incisor is notably displaced (VI_a, VI_b). Radiograph (VI_c) shows the midline position of the supernumerary tooth, and the readiness of the left primary central and lateral incisors to shed. Extracted 5–22–56, the tooth measured 18.4 mm. in length (VI_d). Note size of crown and incomplete root formation, indicating that although the tooth was competing for arch space with the primary dentition, it is in the process of development as a permanent dentition type.

DISCUSSION

The formation of supernumerary teeth and supernumerary structures on teeth is not clearly defined in the literature. Goldman[1] states that the phenomenon suggests a hyperactivity of the dental

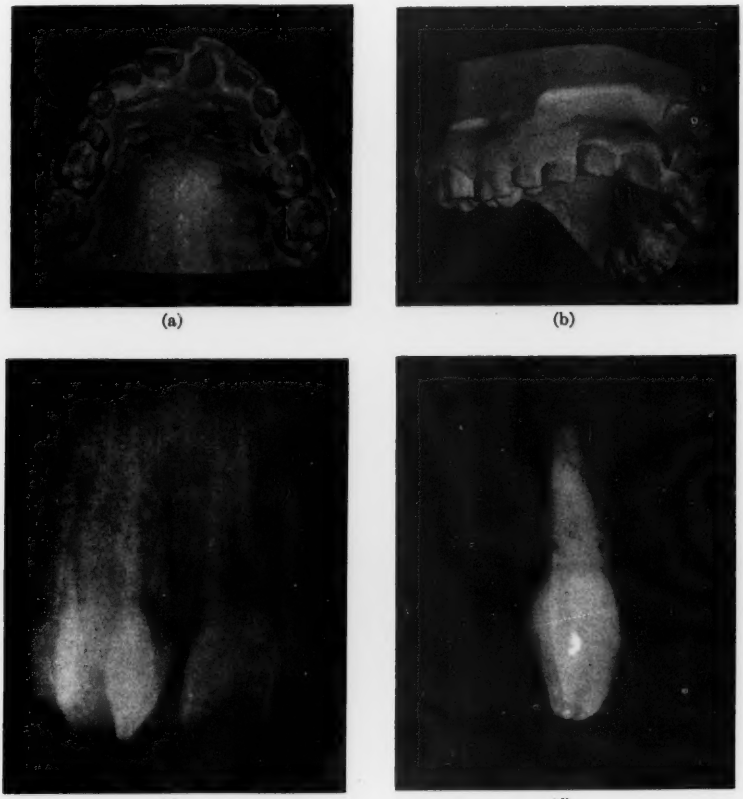
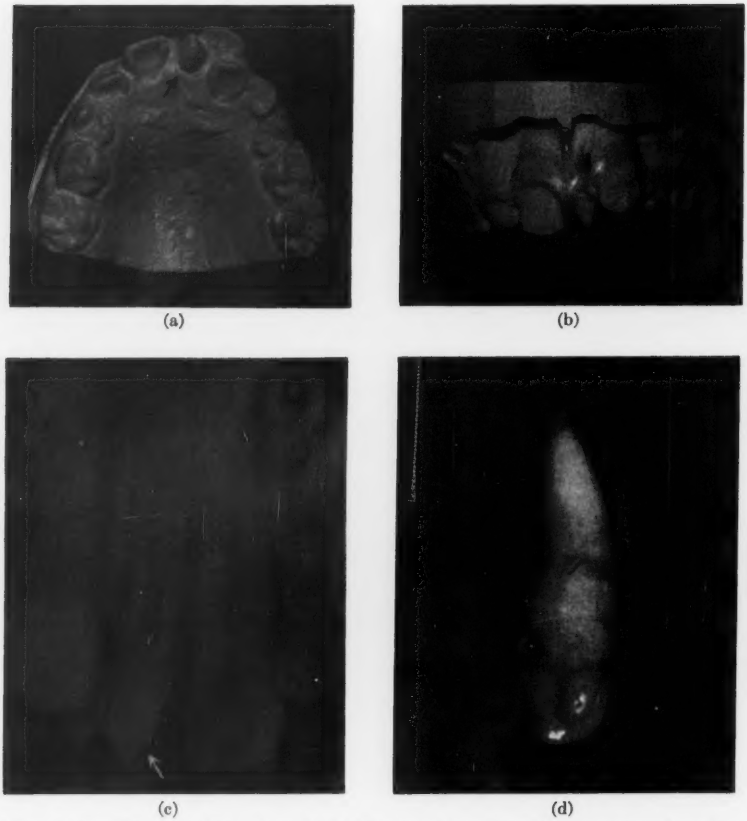


FIG. 3. Case III. (a) Palatal view; (b) labio-buccal view; (c) radiograph; (d) extracted tooth.

lamina. Yet, misplaced and supernumerary tooth germs have been found in such sites as the nasal cavities, the maxillary sinuses, the orbits and the hard palate. Goldman further states that a supernumerary tooth or structure may develop from an abnormal folding of a single enamel organ which process is termed *gemination*. The simplest of this type of phenomenon, according to Goldman, is the enamel pearl. He indicates as other similar conditions: supernumerary cusps, supernumerary crowns, and fused teeth. However, it can be observed that the supernumerary tooth bud often develops in close approximation to a normally forming tooth and does not become an appendage to it. The six cases presented here exhibited supernumerary teeth erupting independently of the other dentition and with the exception of Case VI were in competition with the permanent dentition for arch space. The problem of supernumerary teeth seems to be in the



(a) (b)

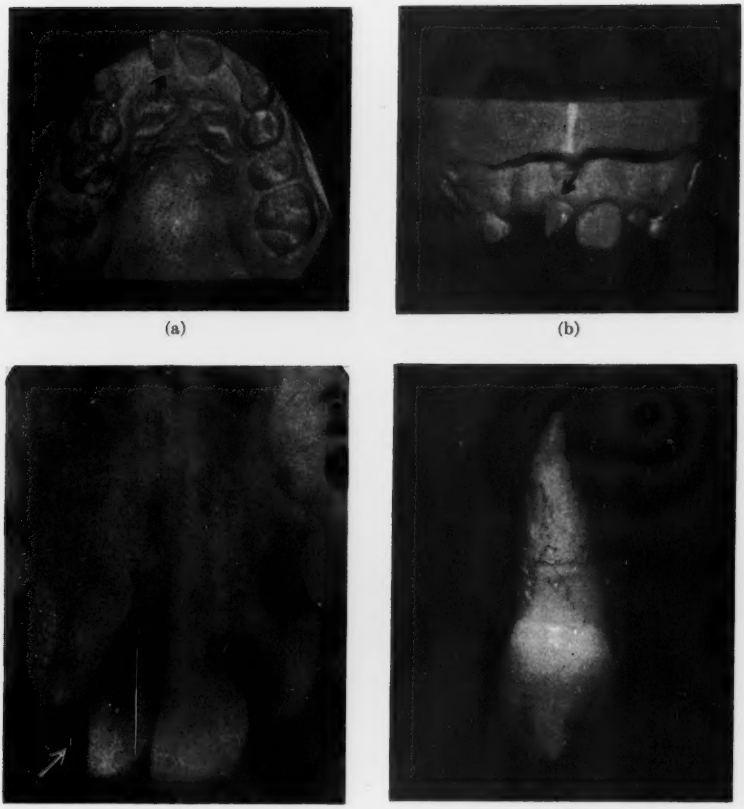
(c) (d)

FIG. 4. Case IV. (a) Palatal view; (b) labial view; (c) radiograph; (d) extracted tooth.

extent to which they damage normal arch alignment and retard permanent tooth eruption. Hypothetically, the impacted supernumerary tooth could cause resorption of the roots of erupted permanent dentition.

Erupted supernumerary teeth are believed by some to exhibit a resistance to dental caries over and above the normal dentition in the same mouth. Case II of this pilot group exhibited marked incisal attrition and a carious lesion, while Case IV presented evidence of decalcification.

Supernumerary teeth are usually peg-shaped in form, with well-demarcated crown and root. It is difficult to categorize these teeth other than by the position in which they erupt. According to Goldman[1], supernumerary "bicuspids" are most frequent in occurrence, sometimes being found bilaterally while supernumerary "cuspids" and "molars" are extremely



(a) (b)

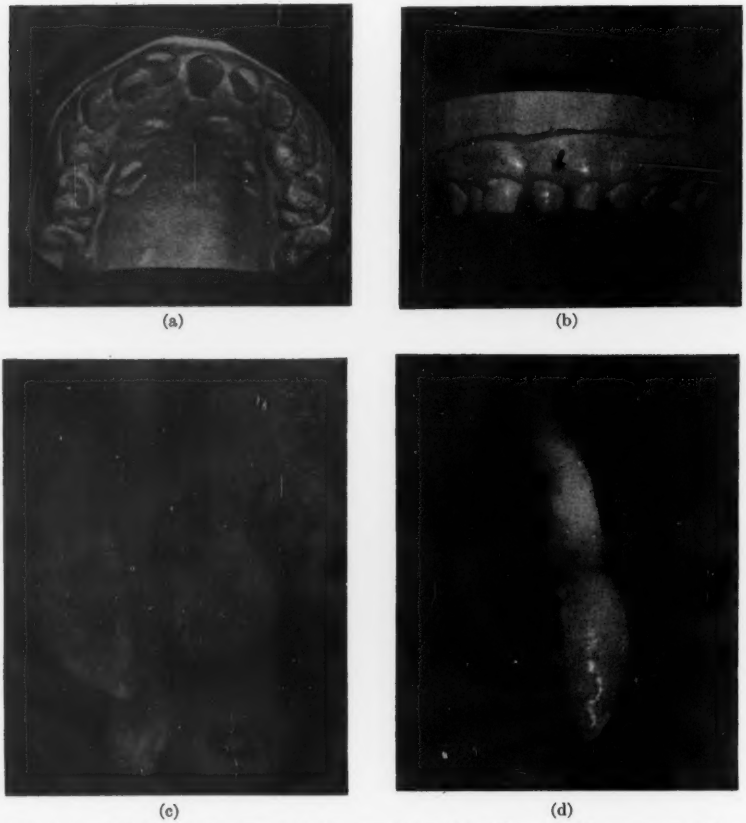
(c) (d)

FIG. 5. Case V. (a) Palatal view; (b) labial view; (c) radiograph; (d) extracted tooth.

rare. All of the six cases presented here had supernumerary "incisors", varying from peg-shaped teeth to teeth with ample dimensions and with marked labial and lingual anatomy.

Cases have been reported in which supernumerary teeth occurred in successive generations of a family. There seems, in addition, to be a wide-spread though unsubstantiated belief that this is a sex-linked inheritance. In the six pilot cases there were five boys and one girl; also, there was a racial factor indicated in that five of the cases were of Latin-American descent and one of Caucasian race. Familial inheritance was indicated in one case.

The phenomenon of supernumerary teeth is believed by some investigators to be a form of atavism.[1, 2] If this is true, then it is the opposite "process" from that of congenital absence. However, the



(a) (b)

(c) (d)

FIG. 6. Case VI. (a) Palatal view; (b) labio-buccal view; (c) radiograph; (d) extracted tooth.

concept of atavism can be questioned in regard to true supernumerary teeth, which occur seemingly at random in the dental arch. Perhaps if statistical data can be provided as to the location of supernumerary teeth and supernumerary tooth buds in the dental arch, a pattern will be noted and the concept of atavism could be better substantiated. At present, atavism would be more logically applied to the fourth and fifth molars frequently reported in the dental literature.

SUMMARY

Each of the cases in this pilot study raised questions regarding supernumerary teeth not adequately answered by the literature. The incidence of supernumerary dentition seems to be high in the public school population of Houston, Texas. Further studies of this population group are now in progress which will encompass the following considerations of supernumerary teeth: 1) Incidence in the school population according to Latin-

American, Caucasian and Negro racial groups; 2) Incidence in the male and female population; 3) Extent of damage to normal arch alignment—pre and post-operative; 4) Incidence of caries and attrition in supernumerary teeth; 5) Percentage of erupted and non-erupted supernumerary teeth; 6) Hereditary factors involved; and 7) Patterns of location of supernumerary teeth in the dental arch.

Conclusion

Occasionally, the profession is confronted with newspaper or word-of-mouth accounts of the eruption of a "third set of teeth". These are considered to be impacted supernumerary teeth erupting independently or after the loss of permanent teeth. As this phenomenon is popularly expounded in the folklore and is of great interest to the general public, dental health education personnel should have a thorough understanding of the factors and manifestations of supernumerary dentition. More information is needed than that found in the individual case reports of supernumerary dentition which prevail in the literature.

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Case Report

GEORGE E. ORSECH, D.D.S.

J. S., a boy, age 9 years 7 months, presented with the anomaly of four completely formed, typical upper permanent "central" incisors. Two normal lateral incisors were present and the rest of the mouth was mixed dentition normal for the age. The four "central" incisors were all of good structure and shape, except that the two median incisors had a slightly more concave lingual contour than did the two distally disposed. There was no history of "extra" teeth in the immediate forebears.

The problem of which two "central" incisors should be removed presented the following questions:

(1) Which pair was the more normal?

(2) Which pair could more easily be moved to the median line into proper position?

The decision to remove the median pair was based on the following: The greater concavity of their lingual surfaces would not permit as satisfactory an occlusion with the lower incisors and, although the distal pair would have to be moved a greater distance, particularly on the right side, their accompanying lateral incisors would probably move with them with a more pleasing result.

Treatment: The median pair of incisors was removed.

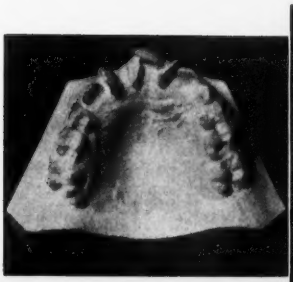
The two remaining central incisors were rotated into arch alignment. This brought the left central almost, but not quite, to the median line.

The right central and lateral incisors were moved mesially, as beads-on-a-string, to the midline, as were the left central and lateral the lesser distance, by means of helical springs on a labial arch. This also opened the spaces for the permanent cuspids which were by that time ready to descend.

The relationship was retained by means of simple bands on the incisors with joining ligatures until the permanent cuspids had completely descended, which they were able to do uneventfully because of the proper timing of the previous attention.

Although supernumerary, mal-formed teeth are relatively common, this case with four fully-formed and normal upper permanent "central" incisors seems worthy of report.

110 E. Main St.
Madison, Wisconsin



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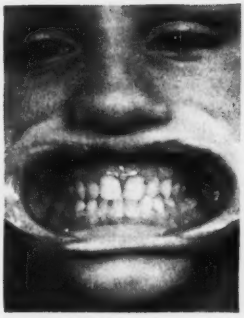

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No. 1. Cast, showing disposition of four "Central" incisors. No. 2. Occlusal view. No. 3. Front view, pre-operative. No. 4. Front view, after removal of median "Central" incisors. No. 5. Occlusal view, post-treatment. No. 6. Front view, post-treatment.

Oral Surgical Problems in Children*

Col. Robert B. Shira, D.D.S.†

ORAL surgical problems in children are essentially the same as those for adults. Because of the age factor and the presence of a mixed dentition, however, many of the conditions encountered in the child require special considerations. Among these are management of the patient; problem of extracting teeth in the presence of acute or chronic infections; problems arising from the difference between the chronological and physiological age of the patient; prolonged retention of primary teeth; uneven resorption of roots of primary teeth with retention of the unresorbed portions; presence of supernumerary teeth and their role in causing pathological conditions and malocclusion; cysts and tumors involving the soft tissue of the oral cavity and the osseous structures of the maxilla and mandible; fractures of the facial bones; and oral manifestations of certain systemic disorders.

All these conditions in the child patient present problems that are frequently different from those of the adult and may require special consideration and specialized forms of therapy. This discussion will consider some of the conditions that present a diagnostic or surgical problem, as well as the proper treatment of the various entities.

Parental Approval of Treatment

Before embarking upon any form of treatment for a child, full parental approval should be obtained. While the child is the recipient of the service, he is usually unable to understand the reason for the contemplated treatment. It should be explained, therefore, in clear and understandable terms to the parents to enable them to have a clear picture of what is being done. Surgical procedures requiring the loss of primary or permanent teeth or portions of the osseous structure may lead to a number of conditions directly affecting the future of the child.[1] This responsibility should be shouldered by the parents as well as the dentist. Furthermore, from a medical-legal aspect, it would be unwise to initiate any service for a child without full parental approval and if the service is to be a surgical procedure, the approval should be in writing.

Extraction of Teeth in Presence of Acute and Chronic Infections

One of the most common surgical problems encountered in the child is the acutely infected tooth and its proper management. The child usually has a swollen face, an elevated temperature, a fretful disposition, and may have spent one or more sleepless night. There is usually marked dehydration, and the child may have eaten little since the onset of the condition. Local examination usually reveals an extremely tender, sore, loose tooth, resulting from an acute periapical abscess. There may or may not be fluctuation in the soft tissue as a sign of localization of the infectious process.

In the past this condition was usually managed in a conservative manner by waiting until the inflammatory process had subsided before extracting the offend-

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ing tooth. Older text books recommend this therapy, stating that extraction of the tooth during the acute stage causes an increase of the inflammatory process with spread of the infection to surrounding soft tissue, lymphatics, blood vessels, and bone. "Never extract a tooth until the condition is improving" is an old adage often quoted.

This conservative treatment was often supplemented by the application of heat in an attempt to localize the infection in the soft tissue so that incision could be made for drainage. After drainage was established and the swelling had subsided, the tooth was extracted. During the course of treatment, the patient was in constant pain, spending sleepless nights, and was unable to eat a normal diet. This, of course, led to exhaustion and lowered resistance.

Safety with Miracle Drugs

It is now realized that many of these old beliefs are open to question and with the advent of newer drugs, modern surgical techniques, and anesthesia, many conditions once considered dangerous may now be treated with safety.[2] The treatment of the acutely infected tooth falls within this category. Many oral surgeons now feel that the conservative treatment is no longer necessary and that immediate extraction of the offending tooth is the treatment of choice. Experience has shown that this treatment may be carried out with a minimum of danger to the patient (Figure 1).

Removing Teeth under Anesthesia

Using adequate preoperative and postoperative antibiotic therapy and removing the offending teeth by an atraumatic surgical procedure under general or regional block anesthesia, an early resolution of the infectious process may be obtained. Extraction usually produces relief from pain, a reduction of the swelling, and a complete dissolution of the suppurative process without untoward complications. A basic surgical principle of "removal of the cause" is satisfied by the immediate extraction, and drainage of the original focus through the socket can take place.[3]

Any collection of pus in the soft tissue can also be evacuated at the same time by adequate incision and drainage. This procedure has invariably resulted in rapid healing, and postoperative complications have been practically unknown. It is safe to say that should any untoward complications develop, they probably would have occurred anyway, and the extraction of the tooth should not be considered as the causative factor.

A problem that should receive equal consideration is the involvement of a tooth with a chronic periapical abscess. It is a common occurrence to see such a tooth, with or without a draining fistula, being retained in a mouth because it is painless. Many times parents have been advised to leave such teeth in place, because they act as good space maintainers and prevent drifting of adjacent teeth. This is poor advice; infection should not be tolerated in any part of the body, and the mouth is certainly no exception.

Disposition of Infected Teeth

A satisfactory disposition should be made of all infected teeth, and if the infection cannot be controlled by pulpotomy or root canal therapy, the tooth should be extracted.[4] A physician would not allow a chronic, infected appendix to remain, because of its possible effect upon the health of the individual. By the same token, the dentist should not allow a chronically infected tooth to remain untreated. Any infection around a tooth

FIG. 1. Left: Acute cellulitis resulting from an infected tooth. Right: the tooth was extracted immediately and the cellulitis rapidly resolved without complication.

that cannot be controlled by adequate root canal therapy should be eliminated along with the offending tooth, and some other means of maintaining the desired space should be employed.

In extracting primary teeth, certain problems are encountered that require special considerations. As a rule, primary teeth are easier to extract than their permanent successors, particularly if their roots have been partially or completely resorbed. But when they must be removed prematurely—before root resorption has taken place—extraction may present a formidable procedure. These teeth often possess long, thin, divergent roots which are firmly attached to the alveolar process and are often as difficult to remove as permanent teeth. In addition, the crown of the developing permanent tooth is often locked between the primary roots and extreme care should be exercised during surgery to prevent injury to this permanent tooth.

REMOVAL OF PERMANENT TOOTH

Occasionally, the permanent tooth may be accidentally removed along with the primary tooth. This is indeed regretable. Careful study of the preoperative roentgenograms should reveal this possibility and when encountered, the primary tooth should be split and removed in sections. This procedure should prevent unnecessary trauma to the underlying permanent tooth.[5] If a permanent tooth bud is accidentally removed, replantation should be considered.

EXAMINATION BY ROENTGENOGRAMS

Many varied and unpredictable conditions occur in the mouths of children and before any surgical treatment is begun, a complete roentgenographic examination should be made. Only in this manner may embarrassing situations be avoided and proper therapy instituted. Conditions, such as abnormal spacing, altered position, or congenital absence of the permanent teeth; lack of root development; supernumerary teeth (as clearly illustrated in Figure 2); pathological abnormalities of the teeth or supporting structures, etc. may be revealed in the roentgenogram. It is indeed embarrassing to remove a primary tooth and find later that the tooth had no permanent successor. Such errors are inexcusable and can only be avoided by the routine use of preoperative roentgenograms.

Since calcification of all permanent teeth except the third molars is under way by the third year, a full mouth roentgenographic survey should be made

not later than 5½ to 6 years of age.[6] Thus any pathological abnormality or condition that might interfere with eruption of the permanent teeth may be detected and corrected before deformity results.

Presence of Supernumerary Teeth

One condition revealed in the roentgenogram that frequently requires early surgical treatment is the presence of supernumerary teeth. These may occur in any position, but are of particular concern when they are found in the region of the maxillary central incisors. In this area, they are called "mesiodens." They are usually found in pairs although they may occur singly. A few may erupt, but the majority are impacted in an inverted position between the central incisors or in the subapical region.[7] They are usually cone-shaped or rudimentary in form, although they occasionally may approach the size and shape of the permanent teeth.

Several abnormalities and pathological conditions may result from the presence of these teeth. They may cause impaction, malposition or rotation of the permanent centrals (as in Figure 3), and, when located directly between the incisors, they may cause the formation of a diastema. Many mesiodens are inverted and, since they tend to erupt, they have a tendency to travel towards the nasal fossa and may actually erupt into the floor of the nose. Cyst formation about the unerupted mesiodens is an ever present potentiality and may lead to extensive destruction of tissue.[8]

Removal of Mesiodens

In order to prevent such deformities and pathological conditions, the mesiodens should be surgically removed. The timing of this procedure is very important. Unless they interfere with normal eruption or normal positioning of the permanent tooth, and cyst formation is not evident around the crown, the removal should be delayed until the roots of the permanent teeth have formed in order to facilitate the removal and prevent injury to these structures. If, however, there is any question of their causing malpositioning or impaction of the permanent teeth, removal should be undertaken immediately. Careful study of the preoperative roentgenograms to locate the tooth definitely, and removal under direct vision after adequate access has been obtained, will insure successful results.

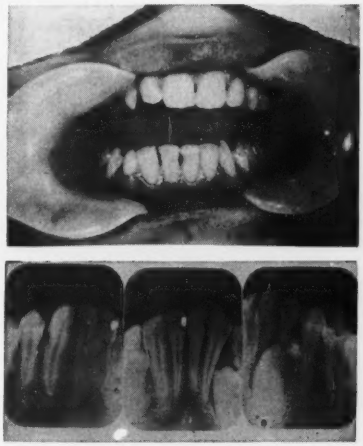

FIG. 2. Uneven eruption pattern caused by a supernumerary tooth. The right mandibular cuspid failed to erupt at the proper time because of the superimposed impacted supernumerary tooth.

Atypical Resorption of Roots

Another surgical problem encountered in the child that has no counterpart in the adult is the condition produced by the atypical resorption of the roots of primary

FIG. 3. Malposition of the central incisor resulting from an impacted mesiodens.

teeth. Occasionally, because of an abnormal position of the developing permanent tooth, the root of a primary molar may start to resorb near the center of the root instead of at the apical region. This resorption may completely separate the unresorbed apical section from the exfoliating coronal portion. The crown of the permanent tooth is usually found well above the level of this retained root tip, locking it deep in the alveolar bone. Because the root is below the bell of the crown of the permanent tooth, its removal, without injury to the developing permanent tooth, is extremely difficult.

There is a difference of opinion regarding the proper treatment of this condition. Some dentists prefer to leave them alone, feeling that the danger of injury to the permanent tooth during surgical removal outweighs any possible danger resulting from retention of the root.[9] Others feel if the roots are left, they may cause further tipping of the tooth, and malocclusion and occlusal discrepancies may result. Still others[10] feel that eventually these root tips will either resorb or be exfoliated. Since retained primary roots are occasionally seen in the roentgenograms of adults, it is obvious that all such roots do not resorb or exfoliate.

No definite statement can be made regarding the proper therapy for this condition. While the surgical operation for removal of the root tip is a difficult, delicate, and tedious procedure, it can be accomplished by the experienced and careful oral surgeon without danger to the permanent tooth. By formation of a large mucoperiosteal flap and removal of sufficient buccal bone to allow good access, the root tip may be removed with small delicate root elevators. Since the crown of the permanent tooth is already calcified, little harm can occur from careful instrumentation in the area, provided the surgeon does not move or dislodge the developing permanent tooth. There should be no hesitancy in the removal of sufficient buccal bone for adequate access, for as healing takes place and new bone is formed, this bone is "brought up" in an occlusal direction with the erupting permanent tooth.

Since asymptomatic retained primary roots may be seen in the roentgenograms

of adults, the dentist who chooses to allow these roots to remain in the dental arch cannot be criticized. Improper surgical intervention may cause damage to the permanent tooth, and, therefore, the inexperienced surgeon would be wise to leave the root tips alone or refer the patient to a specialist for removal.

Ankylosed Primary Molars

Ankylosed primary teeth present a definite surgical problem. This is a condition of unknown etiology. It is characterized by an osseous union between the tooth and alveolar bone which produces a static retention of the involved tooth in the arch.[11] As normal bone growth and eruption of the uninvolved teeth take place, the ankylosed tooth is left behind in infraocclusion and occasionally may become entirely covered by gingival tissue. This condition has been inaccurately referred to as "submerged molars," a term which implies that the tooth is receding into the alveolar bone, when in reality it remains stationary and the other teeth grow away from it. The primary tooth most frequently involved is the mandibular second molar. It is seen less frequently in the upper arch and when it occurs in the maxilla, it is usually accompanied by a similar condition in the lower arch.

The diagnosis of the condition is not difficult. When one or more opposing primary molars are no longer in occlusion, they should be immediately suspected as being ankylosed (refer to Figure 4). Frequently the adjacent teeth have converged and will seemingly "block out" the ankylosed tooth. There is no mobility in the involved tooth even though advanced root resorption may exist. Percussion of the involved tooth will produce a solid sound, giving the impression that the tooth is an integral part of the skull, while percussion of a normal tooth will produce a cushioned or dull sound.[12]

The roentgenogram shows an absence of the periodontal membrane with no demarkation between the tooth and surrounding alveolar bone. The roots may be fully formed or partially resorbed and often there is no permanent successor to the involved tooth.

Complications frequently arise as the result of this condition. As the adjacent teeth continue to erupt, they tend to drift or tilt into the space created by the ankylosed tooth which, accompanied by the lack of development of the alveolar proc-

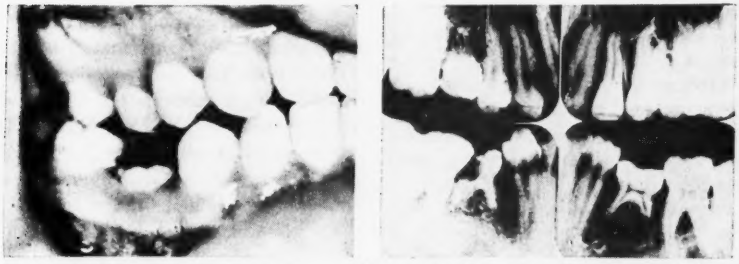

Fig. 4. Ankylosed molars. The deciduous right second molar is out of occlusion, and the adjacent teeth have started to drift into the space with resultant discrepancies of the occlusion. At right, note the absence of the peridental membrane about the ankylosed teeth.

ess in the involved area, contributes to varying degrees of malocclusion. The drifting of the adjacent teeth also leads to loss of normal proximal contact, which may result in increased susceptibility to caries, periodontal pocket formation, and various other conditions.

The condition should be recognized early so that proper treatment can be started before these complications occur.

Surgical removal of the involved tooth is the correct treatment. Since no demarkation between the root and alveolar bone is present, removal becomes a surgical procedure in which the tooth must be dissected from the surrounding bone. This may be accomplished by burs or mallet and chisel after an adequate mucoperiosteal flap has been formed. During the surgical procedure it is also advisable to remove the bone overlying the crown of the permanent tooth, if present, to facilitate its eruption. Orthodontic consultation is usually indicated to determine the necessity for correction of any occlusal disharmonies that may have resulted from the condition.

Retention of Primary Teeth

Often the dentist must make a decision as to the optimal time for removing primary teeth in the older child. Lack of resorption of the roots of primary teeth will often result in prolonged retention of these teeth, which should be prevented by removal at the correct time. While tables of the average chronology of tooth development and eruption are available, these serve merely as a guide; the correct time for removal of the primary teeth must be determined by the clinical and roentgenographic findings in each case, since there is often a marked difference between the chronological and physiological age of patients.

Factor of Root Resorption

The amount of root resorption of the primary tooth and the position and state of development of the permanent tooth, as shown in the roentgenogram, should be the factors in determining if a primary tooth is to be retained or extracted. Usually one-half to two-thirds of the root of the permanent tooth is formed before eruption. If the permanent tooth has reached this state of development and there has been delayed resorption of the roots of the primary tooth, the primary tooth should be removed. This is particularly true if the patient is nearing the fourteenth year of life. Retention of the primary tooth beyond this time may cause a tipping of the permanent tooth and the force of eruption of the permanent tooth may be slowed or entirely lost, causing possible malocclusion or impaction with resultant discrepancies in the dental arch.

Conversely, the early removal of primary teeth may have deleterious effects upon the arch. Early removal of a primary molar may create a space which will allow the adjacent teeth to drift, thus locking the erupting permanent tooth out of its normal position in the arch. The movement also allows the contacts to open on the opposite surfaces of the teeth that have drifted into the space.

This problem will be largely averted if the primary teeth are removed at the proper time. As stated previously, the root of the permanent tooth should be one-half to two-thirds formed, and the crown should be near the surface of the alveolar ridge before the primary tooth is removed. Following removal of a primary tooth, however, the space should be carefully observed and if drifting of the adjacent teeth is noted with opening of the

contacts, the space should be maintained by mechanical means until the erupting permanent tooth has assumed its normal position in the arch.

Tooth within a Tooth

A surgical problem occasionally arises in the tooth involved by *dens in dente*. This condition, resulting from an invagination during the development stage of the tooth, produces a tooth within a tooth.[13] The defect occurs most frequently on the lingual surface of the lateral incisors[14] and can be readily seen on the roentgenogram. A depression is usually noted in the center of this lingual invagination, which may communicate with the pulp chamber of the tooth. This allows an avenue of access to the pulp, and it is not unusual for the infection to enter through this opening and result in death of the pulp with subsequent formation of an acute periapical abscess or radicular cyst.[15]

When an infection has been established through this route, the tooth must either be extracted or treated by root canal therapy. This communication with the pulp chamber occurs in a sufficient number of cases to warrant investigation of all lingual openings in teeth so involved to determine if there is an exposure of the pulp. If a pulpal exposure is found, capping with calcium hydroxide will probably prevent the subsequent death of the pulp with its resultant periapical involvement. If no exposure is found, a restoration can be placed to protect and seal the area.

Herpetic Lesions in the Oral Cavity

An acute infectious disease caused by the herpes simplex virus and known as "primary herpetic gingivostomatitis" is occasionally encountered in the child patient. The initial infection frequently follows such conditions as upper respiratory infections, infectious mononucleosis, or a gastrointestinal disturbance that lowers the child's resistance to the virus.[16] The local symptoms are usually severe and are characterized by a swollen, red, painful, bleeding condition of the oral mucosa and gingival tissues. Before the local lesions appear, however, there is usually an exaggerated systemic response manifested by fretfulness, irritability, excessive drooling, dehydration, acidosis, and altered nutritional intake. As the disease progresses there may be swelling and tenderness of the submental, submaxillary, and cervical nodes, and if the child is articulate, he usually complains of a sore throat or stiffness of the neck.

The disease is accompanied by a marked elevation in temperature which may remain elevated for three to five days and subsides rapidly after the appearance of the lesions on the mucosa. The initial red, swollen, painful mucosal lesions are gradually replaced by vesicles and white spots of varying size. The walls of the vesicles soon rupture and shallow ulcers with irregular, ragged, undermined margins result.

Several of these ulcers may coalesce and form large irregular and painful lesions.[17] In a few days the patient's general condition usually improves and his temperature drops soon after the appearance of the ulcers. The oral lesions gradually recede and show evidence of healing, and the mucosa returns to normal in from ten to fourteen days.

Symptoms for Pediatrician

Frequently this condition is not brought to the attention of the dentist, because the constitutional symptoms of the disease are usually so severe the parents seek the aid of the pediatrician rather than the dentist. But since an occasional patient with the condition is seen

in the dental office, members of the dental profession should be aware of the condition and its treatment.

The condition is classified as a communicable disease and is self limiting in nature. Since a specific remedy is not available, treatment must be symptomatic and supportive. Local application of nonirritating bactericidal drugs, such as gentian violet or acriflavine, are valuable in reducing secondary infection. Aureomycin, either as troches or in some other oral form, may slightly alter the course of the disease if given early. Its primary value, however, is in controlling the secondary infection.

General supportive care, including rest, proper nutrition, and adequate fluid intake, is important and antipyretics are indicated to reduce the temperature. Hospitalization is frequently necessary in the more severe cases to permit isolation and the institution of proper procedure to combat dehydration and acidosis. The disease, being self limiting, runs its course in from ten to fourteen days and the mucosal lesions heal without scarring.

Cysts and Tumors of the Oral Cavity

Many of the benign cysts and tumors found in the adult may also be found in the child. Many of the odontogenic cysts are probably formed in the young patient during odontogenesis. Since, however, they are asymptomatic while small and their enlargement is so gradual, they are frequently not discovered until later in life. For the same reason odontogenic tumors formed in the child patient may not be discovered until later years. With roentgenographic examination of the child becoming more routine, many of these asymptomatic conditions are being discovered at an earlier age.

A variety of odontogenic cysts, ameloblastomas, odontogenic fibromas, calcified odontomas, and reparative giant cell granulomas are among the cysts and tumors which involve the facial bones. While tumors and cysts of the soft tissue occur less frequently in the child than in the adult, occasionally mucous retention cysts, ranulas, papillomas, fibromas, hemangiomas, and lymphangiomas are encountered. Treatment for these conditions is essentially the same for the child as for the adult.

A soft tissue tumor of interest is the so-called "congenital epulis" found in the oral cavity of infants. It occurs more frequently in the female than in the male, may vary greatly in size, is usually freely movable, and is generally the same color as the surrounding oral mucosa. It is most frequently found attached to the incisor regions of the jaws and involves the maxilla more often than the mandible.[18] The genesis of this tumor is questionable, and it has been called granular cell myoblastoma,[19] embryonal hamartoma of the tooth germ,[20] and granular cell fibroblastoma.[21] All agree that it is a benign neoplasm and should be removed by surgical excision. Primary removal with an adequate base usually insures a complete cure and recurrences are rare.

Other Lesions in Newborn

Another lesion occasionally seen in the newborn are the small, fluid-filled vesicles occurring on the mucosa of the alveolar ridge of either the maxilla or mandible. These vesicular-like lesions contain mucous and usually present a typical greyish, "frog belly" appearance, but occasionally they are white and filled with a material closely resembling cholesterol.

The exact nature of these lesions is unknown. They may represent small mucous-retention cysts and have sometimes been referred to as "ectopic" tooth buds, but this concept has not been substan-

FIG. 5. Traumatic lesion of the buccal mucosa resulting from the patient chewing the soft tissues while the area was anesthetized following local anesthesia for the extraction of a tooth. This should be avoided by warning the patient to avoid trauma to the area while the altered sensation persists.

tiated. They present no symptoms and are usually discovered by the nurse or mother when caring for the baby. They are of little clinical significance although they may cause considerable alarm on the part of the parents. They are easily removed by surgical excision, but this surgical intervention is frequently not necessary as the vesicles usually rupture of their own accord in a short time from the trauma associated with nursing and the movement of the tongue and mouth (Figure 5).

APPEARANCE OF SYSTEMIC DISORDERS

The alert dentist should be aware that occasionally some systemic disorder may make its appearance in the oral cavity. Any unusual lesion of the soft tissue or any unusual appearance in the dental roentgenogram should warn the examiner that some systemic condition might possibly be involved.[22] While the dentist is not expected to diagnose many of these conditions, he should realize that they are not of odontogenic origin and refer the patient for proper treatment. Many conditions, such as leukemia, Letterer Siwe disease, Christian's syndrome, eosinophilic granuloma of bone, ectodermal dysplasia, mesodermal dysplasia, primary erythroblastic anemia, sickle cell anemia, cleido cranial dysostosis, and cranial facial dysostosis may have their presenting symptoms in the oral cavity. The well informed dentist should have some knowledge of these conditions and be able to advise his patients on the necessary therapy.

SUMMARY

Because of the age factor, the process of growth and development, and the problems arising from the presence of mixed dentition, many surgical problems are encountered in children that have no counterpart in adults. The general practitioner in dentistry responsible for the dental health of children should be able to recognize these conditions and be cognizant of the accepted therapy for the various entities. Consequently, this discussion has covered the more common of these problems.

Certain entities occurring in the newborn have also been included because of their general interest. Emphasis has been given to the need for recognition and diagnosis of these conditions and while recognized surgical procedures have been mentioned, no attempt has been made to describe exact surgical techniques.

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Psychological Aspects of Disruption of Thumbsucking by Means of a Dental Appliance*

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INTRODUCTION

FOR many years thumbsucking has concerned orthodontists and dentists, on the one hand, and child psychiatrists and psychologists, on the other. The various claims and recommendations of each group usually reflect its members' primary professional concern, and minimize or ignore other aspects of the problem. Most authors acknowledge either the dental or the psychologic features, but base their conclusions on observations in only the one area. Very few reports in the literature describe a coordinated, thorough psychologic investigation during dental treatment for thumbsucking.

We had the chance to make a study when Dr. E. S. Mack of the Mt. Zion Dental Clinic asked us to observe psychologically some of his clinic patients whose thumbsucking was disrupted by means of a dental device. Mack (1), who with Sweet (2) holds that thumbsucking may result in permanent malocclusion and in underdevelopment of upper lip, nose and chest, with mouth breathing and speech defects, advocates the use of a dental appliance on persistent thumbsuckers aged 3½ or older. He recommends dental interference only in cases in which thumbsucking has become an empty and meaningless habit, without explaining how to determine the meaning of the habit.

The device, called a "hay-rake," is a nonremovable appliance cemented to the child's teeth; a series of fence-like tines prevents thumbsucking and tongue-thrusting. Regretting that the appliance looks vicious and has a distasteful name, Mack nevertheless feels that with proper use it is benign and always successful. His concern with the psychologic aspects of this type of treatment led him to query fifteen young patients treated successfully. Almost all replied that they were not angry about wearing the appliance, that it was not difficult to get used to, and that they did not miss sucking their thumbs. Their parents had observed no disturbance or symptom substitution and in fact concluded that the children were more outgoing, and enjoyed other children's company more than before treatment. These replies supported Mack's theory that frustration of an infantile outlet is a necessary experience for growing up and leads to a redirection of energies into more wholesome external pursuits. Since Mack's inquiry permitted only yes and no answers, he correctly decided that a more thorough psychologic evaluation was required. This we set out to do.

EXPERIMENTAL PROCEDURE

The dental clinic referred three children: two white girls, Ann, aged 3 years and 9 months, and Kay, aged 5 years and 7 months; and a negro boy, Jo, aged 3 years and 9 months. These children were selected by the dental clinic on the basis of malocclusion coinciding with either

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thumbsucking or tongue-thrusting and the parents' wish for this kind of treatment. We thus influenced neither the selection nor the decision in any way. The parents, who were all from a low socioeconomic background, generously cooperated in this long investigation. It was stressed that their information was confidential and contributed to our research knowledge. Ann was under observation for 27 months, Kay for a year, and Jo for 20 months.

Careful evaluation of each child was made before insertion of the appliance, to serve as a yardstick for possible future changes. First, an interview with the parent covered the child's complete developmental history and explored parental attitudes and handling of the child. The history included a systematic inquiry regarding the onset, duration, and chronology of an extensive list of common childhood disturbances. Direct observation of the child comprised three free-play interviews, the first preceded by a Stanford-Binet Intelligence Test; the second by a Rorschach; and the third by The Children's Apperception Test. The two latter measures are commonly used personality tests which disclose, through the child's interpretation of ambiguous material, his developmental stage, his fantasy life, his fears and his wishes.

After this evaluation the parent was instructed to report at once any subsequent changes in the child's behavior. The parents were again interviewed routinely about 10 days after insertion of the appliance. We first encouraged them to report their spontaneous observations, and then inquired about changes in the child's appetite, sleep, speech, show of anger, frustration or anxiety, social relations, need for approval and affection. We also checked the previous list of disturbances in order to ascertain shifts in symptom formation. Subsequent interviews with the children followed the earlier pattern, except that the intelligence test was omitted. Interviews with parents and direct observation of the children were repeated whenever the dentists or the parents reported changes in behavior or symptomatology. They were also done immediately before the removal of the appliance, ten days later and again several months later.

Case Summaries

Case 1: Ann, referred to us when she was 3 years and 9 months old, remained under our observation for 2 years and 3 months. The mother's history gave the impression that guilt and conflict over her own oral habits led her to resort to the appliance to combat Ann's thumbsucking. Her pregnancy with Ann was not planned and occurred at a time when the family had suffered serious financial reverses. Ann, like her older sister, was born with a congenital defect of the lower extremities for which she had to wear a brace at night. She was fed by bottle on self-demand schedule. At 7 months she was weaned abruptly within one week. Ann began chewing her fingers as a small infant, and because the child was born with a protruding jaw, her mother tried to prevent this finger chewing.

Ann started to sit, walk and talk at the normal time. Mrs. A. started toilet training extremely early because dirty diapers nauseated her. She began to put Ann on the pot at 3 months, and even before then tried to avoid soiled diapers by anticipating the baby's bowel movements. As soon as she could sit up, Ann was put on the regular toilet until she produced. To this she reacted with temper outbursts. Perhaps because of these early experiences, Ann was still enuretic at night and chose this area in which to please or displease

her mother. Mrs. A. tried unsuccessfully to curb her enuresis through various means.

Ann was described as a cuddly, affectionate, sensitive little girl, of whom other children usually took advantage. Thumbsucking and enuresis were her only symptoms. Before resorting to the appliance, Mrs. A. tried mitts and bitter ointments, to curb Ann's sucking, without success.

Preliminary interviews with Ann established her to be a friendly, cooperative, unanxious little girl of superior intelligence (I.Q. 122). Thumbsucking was noted only when she was extremely fatigued. Her play reflected two main themes: self-consciousness about her deformed leg and conflict whether to please by neatness or express her antagonisms through messiness, the latter a recapitulation of her conflict with her mother over toilet training. Personality tests established that on the whole Ann was an emotionally well adjusted girl who was going through developmental phases appropriate for her age.

Appliance inserted: Observation of Ann a month after she received the appliance showed drastic changes. She was less spontaneous and more irritable, explosive and negativistic. Her play and tests showed an emergence of destructive feelings and anger at her mother for permitting her dental discomfort. Her activities also suggested that, under the impact of this experience, she was reverting to earlier stages of development. In the weeks that followed, her play expressed first an anxious concern with neatness and later an explosive release of aggressive messiness. Prior to this release she seemed depressed and remote, staring into space for long periods of time.

Her mother confirmed these radical changes by reporting symptomatology. Ann had become whiny, belligerent, tense and irritable. Formerly a clinging and affectionate child, Ann now brushed off all tenderness. For the first time in her life she had nightmares. She began to wet again during the day, her speech became more infantile.

In view of the gravity of Ann's reaction we advised, after several weeks' observation, removal of the appliance.

Removal of appliance and later replacements. In the period after removal, Ann improved somewhat, at least psychologically speaking. She immediately reverted to thumbsucking, which now had acquired new meaning. She used it to provoke her mother or else sucked in guilty hiding, usually in closets. Guiltladen she twice said that "maybe the dentist should put back the fence," thereby suggesting that the appliance had now become for Ann an ally against what she had learned to consider her bad impulses.

When the appliance was replaced her symptoms recurred, although with less intensity. Her play now showed distinctly self-punitive patterns. Confirmation of these new tendencies came with a crisis toward which Ann was gradually building up. The dentists, who periodically reported how nicely she was adapting herself to the appliance, were surprised to find her suddenly very much disturbed. Three months after replacement of the appliance, Ann made a big scene while in the dental chair, screaming, refusing to talk and touching her genitals. Not long before, the appliance had become loose and Ann self-punitively allowed it to cause sores on her tongue and gums, without telling anyone what had occurred. In the dental office she accused the dentists of hurting her purposely and at Mrs. A's denial became so angry that she screamed at the assisting nurse, "They're trying to punish me for sucking my thumb."

When the appliance was removed once more, Ann's symptoms again diminished. However, she was now completely at the mercy of her thumb-sucking, which had become compulsive and continuous and caused her tremendous guilt. She confided she could not stop "because it tastes so good." In the grip of a sucking spell she would plead to have "the fence put back."

Because Ann became increasingly self-punitive we advised psychotherapy at this point. Instead, the dental clinic constructed a new, removable appliance, the use of which Ann could control. She used the appliance at school to avoid being teased about thumbsucking. At home she sucked continuously, simultaneously fondling a rubber doll's toes, an act which incensed Mrs. A even more than did the sucking. This confirmed our impression that the sensuous aspects of Ann's habit also upset her mother.

Ann finally brought the appliance, crushed, to the dental clinic. The dental staff then decided to cease further efforts and to give psychotherapy a chance. Ann's symptoms had again become worse; she was withdrawn, sucked her thumb for hours at a time, refused solid food and took refuge in sleeping bouts. Mrs. A., however, consented only reluctantly to psychotherapy.

Mrs. A. withdrew Ann from treatment after only four sessions. Her explanation of startling symptomatic improvement really covered an intense fear of the child's disclosures during the treatment process. Ann's therapeutic hours consisted of a large-scale retaliation spree against all toward whom she felt resentment. This release undoubtedly gave her relief, but did not help her to work through her underlying feelings.

Follow-up: Upon inquiry six months later, Mrs. A. reported that Ann had improved generally: she had gained weight and enjoyed school. However, she sucked her thumb as much as ever, and her mother had finally given up trying to stop her, after Ann said repeatedly: "There isn't a thing you can do, Mommy! I have tried hard enough, haven't I?"

CASE 2: Kay, aged five years and six months at referral, was the child of her mother's second marriage. The father was alcoholic, and the parents had been separated a year. Mrs. D's impulsiveness, as reflected in her indiscrimate involvement in several marriages and unhappy love affairs, made her regard release as a beneficial outlet, and she so considered Kay's thumb-sucking. Only the pediatrician's and the dental staff's persuasiveness and her own mother's influence caused her to agree to the appliance. The grandmother, an extremely rigid woman, tried to squelch in Kay any reminiscent signs of her own daughter's stubbornness. Doubtless she considered thumbsucking a forerunner of the kind of instinctual activity which she could not tolerate in her daughter.

Kay was breastfed for eight months on a four-hour schedule. She was weaned in a month to drinking from a glass. Toilet training was started at nine months; she never ceased being enuretic.

As long as Mrs. D could remember, Kay wanted to be a boy. At 2½ she flew into a rage when a dress was put on her; only school regulations got her out of trousers at the age of 4 and a half. She wore her hair like a boy and had been seen trying to urinate like a boy. She played with dolls only to scalp them or hang them up in cowboy fashion. At school Kay played only with boys, usually more roughly than they. She adored playing with her half-brother, aged 10, and his friends. She early remarked on her brother's penis and asked about breasts.

When told their function, she said she never wanted to have a baby. She was strongly attached to her father and saw him monthly. She often begged her mother never to divorce him, and she took a consistently hostile attitude toward her mother's boyfriends.

In the way of symptoms, Kay frequently vomited to evade school. From her first year she had temper tantrums. Recently she had become afraid of the dark. She talked in her sleep. When she sucked her thumb or thrust her tongue she tried to snuggle up to someone.

Preliminary interviews with Kay established her to be a boyish, intellectually precocious child (I.Q. 131), who demonstrated both in manner and content of play an intensive fear of passivity. To feel any measure of security, she had to take an active, masculine role in handling things. Her tests, drawings and free play all reflected her intense confusion about sex and family roles, and also demonstrated her uneven development. Sucking was noted only when Kay was anxious or feared failure.

Appliance inserted: Kay eagerly anticipated getting a dental device. This eagerness, we found, was based entirely on Kay's desire to be like her brother, for she proudly boasted of having a brace like his. The appliance thus became a tool whereby Kay once more could deny reality and hope to become like a boy. Mrs. D's description of Kay's adaptation to the appliance agreed strikingly with the child's need to master experiences actively. She first tried to suck her thumb despite the brace and then, unable to do so, threatened to yank it out. Subsequently she teased her brother that now she was his equal. Mainly, though, she used the appliance to frighten people, charging, mouth open, as if to bite.

Except for increased restlessness and irritability, Kay showed few changes. Like Ann, Kay did not complain when the appliance caused sores in her mouth and swelling of her cheeks. To her, also, the appliance became a concrete sign of demarcation between "good" and "bad" impulses.

Removal of appliance. Two months after the insertion of the appliance, perhaps disappointed that it did not accomplish its magical purpose, Kay loosened and bent it. At her next appointment, the dentists pronounced the correction of her teeth fairly complete and suggested that the appliance was no longer needed. Kay resolved never to suck her thumb again, but this resolve soon broke down under the stress of a brief illness.

Follow-up: One month after the removal of the appliance the family reported Kay's thumbsucking as unchanged. Eight months later, after a series of traumatic events in the family, Kay was sucking her thumb incessantly.

CASE 3: Jo, the only child of a young negro couple, was referred at the age of 3½ because of lip chewing and tongue thrusting. Jo's mother was rigid, fanatically neat and compulsive; the father, ambitious and stern. Jo was unplanned and unwanted. Mrs. F. had not wished to breastfeed him. When he was 9 months old she began to wean him; when he was a year old, she threw away all his bottles. Though it was really precocious she considered his development slow.

When Jo was 6 weeks old, Mrs. F. began bowel training. She must have caught him always in time, since she could remember no soiled diapers. Ostensibly because his anus was too small, she dilated it, without medical advice, possibly in order to have control over his movements. He was wholly trained at the age of two.

He now wets every four or five months, possibly on purpose.

Persistent eczema, asthmatic attacks and diarrhea since babyhood suggested early psychosomatic symptoms. In addition Jo was afraid of dogs and the dark. He stuttered occasionally. From the first year of life he had indulged in tongue-thrusting, which he liked to combine with touching soft things.

Preliminary interviews showed Jo to be an attractive, extremely passive phlegmatic boy whose I.Q. was in the high average range. All through the interviews he rubbed his tongue gently in a sucking motion against his teeth. There was no thrust in this activity just as there was no vigor in his general demeanor. Equally infantile was his steady insistence that he was 2 years old. Tests substantiated the impression of general immaturity.

Insertion of appliance: Jo adjusted himself very smoothly to the appliance, no doubt because it hindered his sucking in no way. He now simply rubbed his tongue sideways. His mother expressed disgust both about his sucking and the associated sounds. She reported no changes, and none were observed in his behavior. The tests revealed minor ones, in the direction of guilt formation and concern over bodily injury.

After failing to curb Jo's sucking, the dental clinic fitted him with an appliance with longer, sharper prongs. His sucking stopped, and marked, although temporary changes appeared. His mother complained about his assertiveness. He had become active, purposeful and quick in action; and he now expressed a good deal of aggression. His greater vigor may well have been a product of the ingenuity he needed to re-establish his old ways of gratification. This he did in two weeks' time, and as he resumed tongue sucking his old passivity returned.

Removal of appliance and follow up. Upon removal of the appliance eight months after its insertion, the protrusion of Jo's teeth had been corrected, but he had already resumed his sucking. The family reported seven months after the removal that Jo sucked his tongue as much as ever.

Discussion

Analysis of the above case material brings out several points. Comparing early developmental factors in these three cases, for example, we find that each child began sucking during his first year of life. Although this was not brought out in the brief case summaries, all three had been feeding problems ranging from moderate to severe and prolonged ones. All had been weaned abruptly. One of the children was breastfed and another was on self-demand schedule. Two had had extremely early toilet training.

Observation of these children's play, their test results and the fact of their persistent enuresis all suggested an as yet incomplete mastery of urethral control. Child study has established the danger, when one phase of development is prematurely pushed and therefore not mastered, that the child may revert to earlier phases of development. It is therefore quite possible that the early toilet training and abrupt weaning experiences in these children may have contributed to their seeking gratification in thumbsucking. While abrupt weaning and early toilet training may have contributed to the tenacity of these children's sucking, such a causal connection certainly should not be generally assumed on the basis of so few cases. Even in the three observed cases one cannot assume a unilinear causal relationship of these factors, because psychic phenomena are usually multiply determined and are too complex to permit

the establishment of such direct relationships.

In order to understand better the total situation, one must determine what the sucking means to the mother, who after all is the active person to seek a cure through the dental appliance. In our cases, only one mother was generally rigid and condemning of every sort of instinctual activity. To the other two, the child's sucking affected certain focal points of conflict within their otherwise unrigid personalities. Two mothers showed undue disgust, especially with the associated sounds, as if they both sensed and rejected the sexual aspect of the activity. The third seemed both to sense it and to flaunt the child's sucking before her critical family just as she did her own sexual promiscuity.

In considering next what meaning the thumb or tongue sucking had for the children, we found varied meanings, understandable only in the entire context. To none of the three children did the sucking represent an "empty" habit. In one case it was an obvious, admitted source of sensuous gratification; in the second, a consolation whenever the child felt threatened with anxiety or failure; in the third, a part of generalized infantilism and thus not an isolated, meaningless, outgrown habit. The child's reaction after insertion of the appliance showed that the sucking had a definite function in each child's "emotional household." Even granting that habits sometimes outlive their original function and become "empty," this fact cannot be determined except through careful, prolonged, specialized study of each case.

Most important of all, the project showed how impossible it is to understand either the meaning of the sucking to each child or his response to the appliance without prolonged individual study. Even a thorough, preliminary evaluation of each child's personality does not suffice to predict his exact reaction to the appliance. In one case insertion of the appliance produced such drastic new symptoms as night terrors, day wetting, speech disturbance, refusal to eat solids, withdrawal into sleep and belligerent irritability. In the second child, aside from increasing her irritability, the appliance simply consolidated previously existing psychopathology, in that it further supported her unrealistic, magical hope of becoming more like a boy. The third child at first showed no changes because the appliance failed to prevent his sucking. When a larger appliance temporarily did so, this very passive child responded both with aggression and fear of injury. As soon as his sucking was re-established, he relapsed into his former listless passivity.

The diversity of these children's reactions shows the inner reasons why one child will react with more deleterious effects to the appliance than will another. The inner reasons come to light only through the prolonged, cumbersome study of each child's total personality organization that requires the specialized methods of child psychology. Because with even a careful preliminary evaluation one can usually not predict the child's probable reaction, such treatment programs would require continued attention to psychologic aspects—a costly procedure. Since it is often argued that early insertion of a "hay-rake" forestalls more costly orthodontic work later, the cost of psychologic attention should be considered in this comparison.

Aside from their highly individual reactions, all three children showed two side-effects of treatment. One was increased hostility, at both the level of behavior and of fantasy. One child even tried to frighten people with the appli-

ance, the sight of which does elicit a startle reaction in the onlooker. The other side-effect was the children's newly emerging guilt over what they had learned to consider their "bad" impulses. The appliance seemed to become a concrete and tangible ally against these impulses. The two girls especially showed their guilt by bearing, without complaint, the pain caused by the loosened appliance, as if it were deserved punishment. One girl even begged to have the appliance put back because she was now completely at the mercy of her compulsion to suck. Pleas of this kind can be very misleading: The dental clinic staff has interpreted them as signs of the child's eagerness to cooperate rather than as evidence of his guilt.

Parenthetically, we note that the appliance failed to stop thumb or tongue sucking in these three children; instead, it focused the child's attention on thumbsucking. In two cases thumbsucking became compulsive, constant, and intense; one child withdrew into closets to carry out her now guilt-ridden activity.

In a broad context, one of the most important considerations regarding use of dental appliances is the question whether thumbsucking causes permanent damage to the dental structures. Dentists do not agree on this point. Mack (1), Sweet (2) and others warn of dire consequences if thumbsucking is allowed to persist. Others, like Lewis (3) and Sillman (4), after making systematic, longitudinal studies on fairly large groups of thumbsuckers, concluded that it depends greatly on the child's age, type of thumbsucking and the constitutional anlage of the bite whether or not thumbsucking leads to malformations. Lewis found that thumbsucking before the eruption of permanent teeth usually causes no lasting deformities. Sillman pointed out that displacement of the oral structure may occur from vigorous thumbsucking in the first four years, but this corrects itself after thumbsucking stops unless the child has a poor bite to begin with. Extensive serial studies at the University of Michigan on the effects of thumb and finger sucking were recently reported by Ruttle (5) and colleagues; 36 children had definite, persistent oral habits, mostly thumbsucking. The authors conclude: "Contrary to most publications, the effect of thumb and finger habits on the molar occlusion merely approaches statistical significance, and does not attain clinical utility."

Because of these contradictory reports upon the effects of thumbsucking in young children, and since recent systematic and extensive studies show the effect upon malocclusion to be "not nearly as great as is indicated in the literature," we propose the postponement of dental treatment when at all possible.

Psychologically, the years between 3 and 6 are most important because the child tentatively settles his image of his body and its functions and of his parents and his relationship to them. Measures that burden this developmental phase and accentuate its conflicts are therefore inadvisable. Most children give up thumbsucking before the permanent teeth erupt —the time often regarded in dental opinion as critical. By then, the child labors less under instinctual tensions, turns his energies more to outside activities and feels more sensitive to his appearance and to other children's teasing—conditions that help him to give up thumbsucking.

Orthodontic treatment which may later become necessary is thus not hampered by a previous and perhaps traumatic experience. The patient by then has more reason to cooperate with treatment. Preadolescents are particularly conscious of their appearance and eager to fit into their group. The child's greater reasonableness

and his vanity join to enlist his cooperation.

Further research should be done on the entire problem of the effects of persistent oral habits in children. Psychologic observations in a larger series of cases using the "hay-rake" appliance would help to determine what factors in the child's personality organization and home environment contribute to good or poor results. Similar studies on a group of older children undergoing orthodontic corrections would establish whether their psychologic situation differs from that of younger children and is more favorable to treatment.

Summary

Three children below the age of six whose thumb or tongue sucking was disrupted by a dental appliance were under psychologic observation from twelve to twenty seven months. In addition to a complete developmental history, these observations included play and test evaluations before, during and after treatment.

Results indicate that both the meaning to the child of the sucking and his reaction to the appliance were highly individual, and could be understood only in the context of the total case history. Each child's reaction depended on factors which could be brought to light only through prolonged and highly specialized study. Two side-effects which all the children shared were activation of hostility and guilt-reactions.

The appliance failed in all three children to stop sucking, and intensified it in two children.

These findings suggest the desirability of postponing dental treatment until a later age, and emphasize the need for further research.

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Book Reviews

Pediatric Dentistry. M. MICHAEL COHEN, D.M.D., ET AL. First edition 1957. 589 pages, 395 illustrations. Price $14.75. C. V. Mosby Co. St. Louis 3, Mo.

In this textbook, the author and his impressive array of sixteen collaborators present a comprehensive coverage of the many phases of dentistry for children, with chapters dealing with the embryological development of the head, face and oral cavity up to and including interceptive orthodontic care for the developing dentition.

Of especial interest is that portion of the book dealing with dentistry for the handicapped child, a subject heretofore not discussed at any length in textbooks of pedodontics. Precise descriptions of various handicaps are given, and following a discussion of their oral manifestations, accepted procedures for adequate dental care are set forth in comprehensive, easy reading. Although a minimum of dentists who care for children will be able to avail themselves of general anesthesia for operative procedures, most will appreciate the section devoted to that subject and if it does nothing more than focus attention on that phase of pedodontics, the book will be helpful.

Likewise, the section on "Oral Surgical Problems in Childhood" is outstanding in its comprehensive coverage of the subject.

Although the chapter dealing with the psychological development of the child quite obviously stops short of a discussion of the behavior of the child in dental situations, the information set forth might enable a dentist to recognize psychological aspects of an abnormal or undesirable behavior and encourage him to seek an understanding of the child.

To those who seek a concentrated, yet comprehensive discussion of the problems of operative dentistry for the child, including pulp management and fractured anteriors, the text may seem inadequate.

The many fine illustrations and photographs presented add much to this book, and their free use serves to supplement the written descriptions.

All in all, this text is one which should be used by every dentist who cares for children, for in its pages there is a wealth of useful, appropriate information.

A.E.S.

Introductory Psychosomatic Dentistry. MANHOLD, JR., J. H. New York, Appleton-Century-Crofts, Inc., c 1956. x+193 p. $5.00.

The title of this book will be misleading to many who read it. While it is true that the subject matter is valuable as background material for introduction to psychosomatic dentistry, the book is neither extensive nor comprehensive enough to examine this large field of study to satisfy the requirements of an introductory work. It is, however, an excellent exercise in statistical evaluation. The apparent desire for mathematical accuracy and selection of study material enables the author to receive considerable credit for establishing a scientific relationship between dental pathology and psychological aberrations.

An expanded study is made of U. S. naval air cadets ranging between 18 to 27 years of age and living under similar circumstances for a considerable period of

time. But other sources of material are also utilized in comparison. The degree of significance is interesting and valuable.

Part I of this book comprises ¾ of the work and is involved with the mechanics of statistics. The author appears to have limited knowledge of what many highly trained men are now accomplishing with the principles of psychosomatic dentistry. He early discards "hypnosis" as a workable tenet but part II of the book contains a few suggested homilies which are nothing more than utilization of the weakened state of suggestion plus the personal competence of the operator.

We cannot help but feel that this book has been somewhat abrogated from the author's original sincere intent and purpose to be slanted toward the present trend of interest being exhibited in control of dental problems with psychosomatics. In reality, it may stand without such support on its own merit as a devoted effort to compile and analyze statistical evidence essential to research in psychosomatics.

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